GLOBAL TUBERCULOSIS REPORT
SUPPLEMENTARY MATERIAL

Warning: This report is out of date. In particular, entire time-series of TB disease burden estimates are updated every year. For the latest data and analysis, please see the most recent edition of the global TB report.

2021
similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by WHO to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall WHO be liable for damages arising from its use.
# Contents

1. The COVID-19 pandemic and TB ................................................................. 1
2. TB disease burden .......................................................................................... 10
  2.1 TB incidence .............................................................................................. 10
  2.2 TB mortality ............................................................................................... 21
  2.3 National TB prevalence surveys ................................................................. 33
3. TB diagnosis and treatment ........................................................................... 42
  3.1 Case notifications ....................................................................................... 42
  3.2 Diagnostic testing for TB, HIV-associated TB and drug-resistant TB .............. 51
  3.3 TB treatment and treatment coverage ......................................................... 61
  3.4 Drug-resistant TB treatment ....................................................................... 71
4. TB prevention ................................................................................................ 77
5. Financing for TB prevention, diagnostic and treatment services ....................... 85
6. UHC and TB determinants ............................................................................ 96
  6.1 Universal health coverage .......................................................................... 96
  6.2 National surveys of costs faced by TB patients and their households .......... 104
  6.3 TB determinants ....................................................................................... 108
7. TB research and innovation ........................................................................... 114
  Featured topics ............................................................................................. 121
  Digital, case-based, real-time surveillance for TB: status of progress ...................... 121
  Country success stories in implementing innovative TB responses to the COVID-19 pandemic .... 125
  The COVID-19 pandemic and TB in India: impact and response ....................... 129
  The WHO multisectoral accountability framework for TB (MAF-TB): progress in adaptation and implementation ................................................................. 137
  TB and diabetes ............................................................................................ 145
  WHO TB guidelines: recent updates .............................................................. 149
The coronavirus (COVID-19) pandemic has caused enormous health, social and economic impacts in 2020 and 2021. This includes impacts on the provision of and access to essential tuberculosis (TB) services, the number of people diagnosed with TB and notified as TB cases through national disease surveillance systems, and TB disease burden (incidence and mortality). The World Health Organization’s (WHO’s) Global tuberculosis report 2020 (1) included provisional estimates of the impact of disruptions to health services caused by the COVID-19 pandemic on the number of global TB deaths in 2020 and beyond, provisional data on TB notifications in the first 6 months of 2020 and data about response strategies implemented by national TB programmes (NTPs).

A widely available indicator that can be used to assess the impact of disruptions caused by the COVID-19 pandemic on essential TB services at country level is the national number of monthly or quarterly notifications of people diagnosed with TB. This indicator reflects impacts on access to diagnosis and treatment on both the supply side (e.g. capacity to continue to provide services) and the demand side (e.g. willingness and ability to seek care in the context of lockdowns and associated restrictions on movement, concerns about the risks of going to health care facilities during a pandemic, and stigma associated with similarities in symptoms related to TB and COVID-19). After successfully collecting such data from 14 high TB burden countries for January–June 2020 (1), in January 2021 WHO established a global system for regular collection of monthly and quarterly notification data from more than 100 countries, initially for the whole of 2020 and then for 2021, with visualizations of all reported data available in real time (2–4).

Following large increases in the global number of TB case notifications per year between 2017 and 2019, the reported data show a substantial fall of 18% between 2019 and 2020, from 7.1 million to 5.8 million (Fig. 1.1). This set back, coupled with continued disruptions in 2021, mean that the United Nations (UN) high-level meeting target of treating 40 million people diagnosed with TB in the 5-year period 2018–2022 is off-track.

A similar pattern of increases in notifications up to 2019 followed by a sharp fall in 2020 is also evident in four of the six WHO regions (Fig. 1.2), with particularly large absolute and relative reductions in the regions of South-East Asia and the Western Pacific. In combination, these two regions accounted for 84% of the global reduction in TB case notifications between 2019 and 2020. The decline in the WHO African Region was much more modest (2.5%). In the WHO European Region, there was a clear discontinuity in an existing downward trend in notifications (reflecting an underlying decline in TB incidence), suggesting that detection and reporting of TB cases in this region was also affected by the COVID-19 pandemic.
Monthly and quarterly TB notifications in 2020 and the first half of 2021 were substantially below the average for 2019 in most of the high TB burden countries (Fig. 1.3, Fig. 1.4), with the largest relative reductions in annual notifications between 2019 and 2020 seen in Gabon (80%), the Philippines (37%), Lesotho (35%), Indonesia (31%) and India (25%) (Fig. 1.5). Exceptions to this general pattern included the Democratic Republic of Congo, Nigeria, the United Republic of Tanzania and Zambia (Fig. 1.3).

Reasons for regional and country variation in TB notification trends between 2019 and 2020 include differences in when they were first affected by the COVID-19 pandemic, the severity of the impact, the extent to which restrictions were put in place and adhered to, and the capacity and resilience of health systems.

Data presented elsewhere in this report suggest that other impacts associated with the COVID-19 pandemic include a 15% decline in people enrolled on treatment for MDR/RR-TB (Section 3.4); a downturn in the number of people initiated on TB preventive treatment between 2019 and 2020 (from 3.6 million to 2.8 million; Section 4); a reduction in spending on TB prevention, diagnostic and treatment services between 2019 and 2020 (from US$ 5.8 billion to US$ 5.3 billion; Section 5); and a reduction in coverage of the bacille Calmette-Guérin (BCG) vaccine among children between 2019 and 2020 (5% or more in 31 countries; Section 4).

The monthly and quarterly notification data reported by countries for 2020 have been used to produce provisional global, regional and country-specific estimates of TB incidence and TB mortality for that year. Dynamic models were developed for 16 countries, prioritized based on the size of their contribution to the global shortfall in TB notifications in 2020 compared with 2019 (Fig. 1.6). It was assumed that reductions in notifications in 2020, relative to the expected number of monthly or quarterly notifications in 2020 based on extrapolation of pre-2020 trends, were attributable to delays in diagnosis and initiation of treatment. Results were then extrapolated to other low- and middle-income countries using a statistical model. For high-income countries, incidence was estimated using case notification data with a standard adjustment, whereas mortality was estimated using data from national vital registration systems. Further details about methods are provided in Section 2 and a technical annex.

Globally, disruptions to the provision of and access to TB diagnostic and treatment services due to the COVID-19 pandemic are estimated to have caused an increase of about 100 000 in the global number of TB deaths between 2019 and 2020 (an increase from 1.2 million to 1.3 million in HIV-negative people, with about 5000 additional TB deaths among HIV-positive people). These disruptions have also caused a slight slowing in the annual decline in the global TB incidence rate (Section 2).

Projections of TB incidence and mortality for the 16 modelled countries up to 2025 suggest that these impacts will be much larger in 2021 and beyond, especially on TB mortality in 2021 and TB incidence in 2022 (Fig. 1.7, Fig. 1.8). In 2021, TB mortality is projected to be much higher than in 2020 in all of
these 16 countries and by 2022, TB incidence is projected to be above the level of 2020 in most of them, consistent with other modelling projections published in 2020 (5–8). Moreover, these impacts could be underestimates because the modelling does not yet account for the impact of the COVID-19 pandemic on broader TB determinants, such as levels of poverty and undernutrition, which increase the rate of disease breakdown among infected individuals. Declines in income may also affect health care seeking behaviour when people become unwell, causing delays in TB diagnosis and treatment.

There is a strong association between the TB incidence rate and both average income (measured as gross domestic product [GDP] per capita) and the prevalence of undernutrition (Section 6).

There are two main reasons for the more delayed impact on TB incidence compared with TB mortality. The first is that disruptions to diagnostic and treatment services affect those who already have TB disease first, resulting in an increase in the number of deaths. The second is that the impact on incidence of the increased pool of prevalent cases that develops as more people with TB are not diagnosed and treated is slow, due to the relatively long period of time between the acquisition of infection and the development of disease (which ranges from weeks to decades). Other sources of information about the impact of the COVID-19 pandemic on TB include a review of data published between January 2020 and March 2021 (9), a study of changes in TB services provided in 19 countries between 2019 and 2020 (10) and a compendium of research studies related to TB and COVID-19 (11).

WHO has issued guidance on TB in the context of the COVID-19 pandemic (12, 13). Advice includes:

- leverage the expertise and experience of NTPs, especially in rapid testing and contact tracing, for the COVID-19 response;
- maximize remote care and support for people with TB by expanding the use of digital technologies;
- minimize the number of visits to health services that are required during treatment, including through the use of WHO-recommended, all-oral TB treatment regimens and community-based care;
- limit the transmission of TB and COVID-19 in congregate settings and health care facilities by ensuring basic infection prevention and control for health staff and patients, cough etiquette, and patient triage;
- support the provision of TB preventive treatment by building synergies with contact-tracing efforts related to COVID-19;
- provide simultaneous testing for TB and COVID-19 for individuals when indicated, including by leveraging TB laboratory networks and platforms; and
- ensure proactive planning and budgeting for both conditions (including for the catch-up phase), procurement of supplies and risk management.
Content related to TB has also been included in WHO guidance on maintaining essential health services and the role of community-based care during the COVID-19 pandemic (14, 15).

The top priority for the rest of 2021 and 2022 is to try to restore access to and provision of essential TB services such that levels of TB case detection can recover to at least 2019 levels.

**Fig. 1.1** Global trend in case notifications of people newly diagnosed with TB, 2016–2020

![Graph showing global trend in case notifications of newly diagnosed TB cases, 2016-2020.](image)

**Fig. 1.2** Trends in case notifications of people newly diagnosed with TB by WHO region, 2016–2020

![Graphs showing trends in case notifications of newly diagnosed TB cases by WHO regions, 2016-2020.](image)
Fig. 1.3 Trends in monthly or quarterly notifications of TB cases in selected high TB burden countries, January 2020–June 2021

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

---

* Data are shown for countries that were able to report provisional national numbers for all months or quarters to WHO by July 2021.
**Fig. 1.4** Trends in monthly notifications of TB cases in India, January 2020–June 2021\(^2\)

![Graph showing trends in monthly notifications of TB cases in India, January 2020–June 2021.](image)

\(^2\) These data were accessed from [https://reports.nkilohy.org/Reports/TBNotif trickle](https://reports.nkilohy.org/Reports/TBNotif trickle) on 30 July 2021.

**Fig. 1.5** TB notifications in 2020 compared with 2019 in the 30 high TB burden countries

![Bar chart showing TB notifications in 2020 compared with 2019 in the 30 high TB burden countries.](image)

Percentage of TB notifications in 2020 compared with 2019

- Gabon
- Philippines
- Lefoko
- Indonesia
- India
- Myanmar
- Bangladesh
- Ethiopia
- Namibia
- Liberia
- Angola
- China
- Senegal
- Brazil
- Mongolia
- Uganda
- South Africa
- Papua New Guinea
- Congo
- Democratic People’s Republic of Korea
- Ethiopia
- Viet Nam
- Morocco
- Thailand
- United Republic of Tanzania
- Central African Republic
- Zambia
- Democratic Republic of the Congo
- Nigeria

6
Fig. 1.6 The 16 countries with the largest contributions to the global shortfall in TB notifications in 2020 compared with 2019.

Fig. 1.7 Estimated impact of the COVID-19 pandemic on TB mortality for 16 selected countries, up to 2025.

Standardized TB mortality rate (including HIV). The black line indicates the baseline assuming no COVID-19 disruptions, and the red line is the modelled impact.
These estimates are standardized so that rates in January 2020 equal 100 and all subsequent rates are relative to January 2020. For example, a reading of 115 translates into a 15% increase relative to January 2020. Baseline is a scenario of no COVID-19 disruptions based on pre-2020 trends. The impact of COVID-19 related disruptions on estimated mortality is noticeable from 2020 onward.

**Fig. 1.8** Estimated impact of the COVID-19 pandemic on TB incidence for 16 selected countries, up to 2025

Standardized TB incidence rate. The black line indicates the baseline assuming no COVID-19 disruptions, and the blue line is the modeled impact.

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

2. TB disease burden

2.1 TB incidence

In the late 1800s, tuberculosis (TB) was one of the leading causes of ill health and death in most of the world. With social and economic development – such as improvements in hygiene, incomes, housing and nutrition – numbers of TB cases and deaths started to decline in western Europe, North America and other parts of the industrialized world around the turn of the 20th century. From the 1940s, the discovery, development and use of effective drug treatments substantially accelerated these trends, with national case rates (per person) falling by up to 10% per year and mortality rates falling even faster. Countries that have experienced such reductions in TB disease burden now have only about 10 or fewer cases and less than 1 death per 100,000 population per year.

Globally and in many countries, however, TB remains a major cause of ill-health and mortality.

Global targets and milestones for reductions in the burden of TB disease (defined in terms of TB incidence and the number of TB deaths) have been agreed by all Member States of the World Health Organization (WHO) and United Nations (UN), through their adoption of the WHO End TB Strategy (2016–2035) at the World Health Assembly in 2014 and the Sustainable Development Goals (SDGs) at the UN General Assembly in 2015.

For TB incidence, the first milestone of the End TB Strategy is a 20% reduction in the TB incidence rate (the number of new and relapse cases per 100,000 population per year) by 2020 compared with 2015. The next 2025 milestone is a 50% reduction compared with 2015, followed by targets for reductions of 80% by 2030 and 90% by 2035. SDG 3 includes a target to end the global TB epidemic by 2030, with TB incidence per 100,000 population per year defined as the indicator for measuring progress.

Reaching the milestones and targets 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. When the milestones and targets were established, key requirements to reach them were identified; they included provision of TB prevention, diagnostic and treatment services within the context of progress towards universal health coverage (UHC), multisectoral actions to address broader social and economic determinants of TB and technological breakthroughs (such as a new vaccine by 2025)(1, 2).
Estimates of TB incidence in 2020 should be regarded as provisional (Box 2.1.1). As in recent years, they suggest that a global total of about 10 million people fell ill with TB in 2020, with a best estimate of 9.9 million (95% uncertainty interval [UI]: 8.9–11 million), equivalent to 127 cases ([UI]: 114–140) per 100 000 population (Table 2.1.1). The annual rates of decline in both figures slowed compared with the previous year (1.9% for the incidence rate and 0.87% for the absolute number of cases between 2019 and 2020, compared with 2.3% and 1.2% respectively between 2018 and 2019), but continued the downward trends that have been evident since 2000 (Fig. 2.1.1). The cumulative reduction in TB incidence per 100 000 population from 2015 to 2020 was 11%, only just over half-way to the 2020 milestone of the End TB Strategy (right panel of Fig. 2.1.1).

The impact on TB incidence of shortfalls in TB case detection that resulted from disruptions caused by the COVID-19 pandemic was limited in 2020, especially compared with the impact on TB deaths (Section 2.2). There are two main reasons for the more delayed impact on TB incidence compared with TB deaths. The first is that disruptions to diagnostic and treatment services affect those who already have TB disease first, resulting in an increase in the number of deaths. The second is that the impact on incidence of the increased pool of prevalent cases that develops as more people with TB are not diagnosed and treated is slow, due to the relatively long period of time between the acquisition of infection and the development of disease (which ranges from weeks to decades). However, projections of TB incidence that account for the impact of the COVID-19 pandemic in 16 priority countries with 71% of global TB incidence in 2020 suggest that TB incidence could increase globally in 2022 and 2023 (Section 1).

More positively, the WHO European Region reached the 2020 milestone, with a reduction of 25% between 2015 and 2020, and the WHO African Region came very close, with a reduction of 19% (Fig. 2.1.2). The decline in the TB incidence rate in the WHO European Region was driven by the Russian Federation, where the rate fell 6.0% per year between 2010 and 2020. In the WHO African Region, several countries in southern Africa achieved impressive reductions of 4–10% per year, following a peak in the HIV epidemic and the expansion of TB and HIV prevention and care. Coverage of antiretroviral treatment (ART) increased from an estimated 24% of people living with HIV in 2010 to 51% in 2015 and 73% in 2020 (88% among notified cases of TB among people living with HIV).

Progress has been much slower in three other WHO regions (Fig. 2.1.2), with cumulative reductions of 4.9% in the Eastern Mediterranean Region, 11% in the South-East Asia Region and 6.7% in the Western Pacific Region for the period 2015–2020. Of concern is the WHO Region of the Americas, where incidence appears to be slowly increasing after many years of decline, owing to an upward trend in Brazil during 2016–2020.

Among the 30 high TB burden countries, six have reached the 2020 milestone: Ethiopia, Kenya, Myanmar, Namibia, South Africa and the United Republic of Tanzania (Fig. 2.1.3a). A total of 86
countries reached the 2020 milestone, including all three global TB watchlist countries (Cambodia, Russian Federation, Zimbabwe) (Fig. 2.1.3b).

Geographically, in 2020, most TB cases were in the WHO regions of South-East Asia (43%), Africa (25%) and the Western Pacific (18%), with smaller shares in the Eastern Mediterranean (8.3%), the Americas (3.0%) and Europe (2.3%). The 30 high TB burden countries (shown in Fig. 2.1.3a) accounted for 86% of all estimated incident cases worldwide, and eight of these countries (Fig. 2.1.4) accounted for two thirds of the global total: India (26%), China (8.5%), Indonesia (8.4%), the Philippines (6.0%), Pakistan (5.8%), Nigeria (4.6%), Bangladesh (3.6%) and South Africa (3.3%).

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 (Fig. 2.1.5). In 2020, 57 countries had a low incidence of TB (<10 cases per 100 000 population per year), mostly in the WHO Region of the Americas and WHO European Region, plus a few countries in the WHO Eastern Mediterranean and Western Pacific regions. There were 150–400 cases per 100 000 population in most of the 30 high TB burden countries, and more than 500 cases per 100 000 population in the Central African Republic, the Democratic People’s Republic of Korea, Gabon, Lesotho, Philippines and South Africa.

Among all TB cases, 8.0% were among people living with HIV (Table 2.1.1). The proportion of TB cases coinfected with HIV was highest in countries in the WHO African Region, exceeding 50% in parts of southern Africa (Fig. 2.1.6).

TB affects people of both sexes and all age groups (Fig. 2.1.7). The highest burden is in adult men, who accounted for 56% of all TB cases in 2020; by comparison, adult women accounted for 33% and children for 11%. The higher share of TB cases among men is consistent with evidence from prevalence surveys, which show that TB disease affects men more than women, and that gaps in case detection and reporting are higher among men (Section 2.3).

Further country-specific details about estimates of the number of incident TB cases and TB incident rates are available in the Global tuberculosis report app and online country profiles.
Box 2.1.1

Methods used by WHO to estimate TB incidence

The main methods used by WHO to estimate TB incidence at country level in the period 2000–2019 and for 2020 specifically are shown in Fig. 2.1.8a and Fig. 2.1.8b. These methods adhere to global guidelines for accurate and transparent reporting of health estimates (3) and are described in detail in a technical annex. Methods used by WHO to estimate TB incidence for 2000–2019 included:

- results from TB prevalence surveys combined with estimates of the duration of disease, used for 29 countries with about two-thirds of the global number of incident TB cases in 2019;
- notifications adjusted by a standard factor to account for underreporting, overdiagnosis and underdiagnosis, used for 139 countries (including most high-income countries and selected middle-income countries) with about 6.1% of the global number of incident TB cases in 2019;
- results from national inventory studies that measured the level of underreporting of detected TB cases, used for eight countries with about 17% of the global number of incident TB cases in 2019; and
- case notification data combined with expert opinion about case-detection gaps, used for 39 countries with 11% of the global number of incident TB cases in 2019.

To estimate TB incidence in 2020, new methods were required. Dynamic models of TB transmission were used for 16 priority countries, informed by monthly and quarterly notification data reported for 2020. A statistical model was developed to extend estimates to 111 low and middle-income countries. Notification data with a standard adjustment were used for high-income countries. Estimates for 2020 should be considered provisional; underlying data and methods will be further extended and refined in 2021 and 2022.
### Table 2.1.1 Global and regional estimates of TB incidence, numbers (in thousands) and rates (per 100 000 population) in 2020

<table>
<thead>
<tr>
<th>Region or country group</th>
<th>Population</th>
<th>Number of cases (in thousands)</th>
<th>Rate per 100 000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>HIV-positive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Best estimate</td>
<td>Low</td>
</tr>
<tr>
<td>African Region</td>
<td>1 120 000</td>
<td>2 400</td>
<td>2 190</td>
</tr>
<tr>
<td>Region of the Americas</td>
<td>1 020 000</td>
<td>2 011</td>
<td>2 700</td>
</tr>
<tr>
<td>South-East Asia Region</td>
<td>2 020 000</td>
<td>2 327</td>
<td>3 420</td>
</tr>
<tr>
<td>European Region</td>
<td>933 000</td>
<td>230</td>
<td>201</td>
</tr>
<tr>
<td>Eastern Mediterranean Region</td>
<td>731 000</td>
<td>821</td>
<td>648</td>
</tr>
<tr>
<td>Western Pacific Region</td>
<td>1 640 000</td>
<td>1 800</td>
<td>1 480</td>
</tr>
<tr>
<td>High TB burden countries</td>
<td>4 800 000</td>
<td>8 500</td>
<td>7 620</td>
</tr>
<tr>
<td>Global</td>
<td>7 770 000</td>
<td>9 870</td>
<td>8 880</td>
</tr>
</tbody>
</table>

### Fig. 2.1.1 Global trends in the estimated number of incident TB cases (left) and the incidence rate (right), 2000–2020

Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.
Fig. 2.1.2 Trends in estimated TB incidence rates by WHO region, 2000–2020

Total TB incidence rates are shown in blue and incidence rates of HIV-positive TB are shown in light blue. The black solid lines show notifications of new and relapse cases for comparison with estimates of the total incidence rate. Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.
Fig. 2.1.3a Trends in estimated TB incidence rates in the 30 high TB burden countries compared with notifications of new and relapse cases, 2000–2020

TB incidence rates are shown in blue. The black solid lines show notifications of new and relapse cases for comparison with estimates of the total incidence rate. Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2000 milestone of the End TB Strategy.

Fig. 2.1.3b Trends in estimated TB incidence rates in the 3 global TB watchlist countries compared with notifications of new and relapse cases, 2000–2020

TB incidence rates are shown in blue. The black solid lines show notifications of new and relapse cases for comparison with estimates of the total incidence rate. Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2025 milestone of the End TB Strategy.
**Fig. 2.1.4** Estimated TB incidence in 2020, for countries with at least 100,000 incident cases

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

**Fig. 2.1.5** Estimated TB incidence rates, 2020
**Fig. 2.1.6** Estimated HIV prevalence in new and relapse TB cases, 2020

**Fig. 2.1.7a** Global estimates of TB incidence (black outline) and case notifications of people newly diagnosed with TB disaggregated by age and sex (female in purple; male in green), 2020
Fig. 2.1.7b Regional estimates of TB incidence (black outline, in thousand) and case notifications (in thousand) of people newly diagnosed with TB disaggregated by age and sex (female in purple; male in green), 2020

Fig. 2.1.8a Main methods used to estimate TB incidence up to 2019
References

2.2 TB mortality

Tuberculosis (TB) is preventable and curable, and some countries have already reduced their burden of TB disease to fewer than 10 cases and less than 1 death per 100,000 population per year (Section 2.1). Globally and in many countries, however, TB remains a leading or major cause of ill-health and mortality.

The World Health Organization (WHO) End TB Strategy includes global targets and milestones for substantial reductions in the annual number of TB deaths between 2016 and 2035. The first milestone is a 35% reduction by 2020 compared with 2015. The next 2025 milestone is a 75% reduction compared with 2015, followed by targets for reductions of 90% by 2030 and 95% by 2035. Reaching these milestones and targets requires achievement of global milestones and targets for reductions in the number of people who develop TB each year (Section 2.1) and 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. The latter can only be achieved if everyone who develops TB can access high-quality TB treatment.

Based on the international classification of diseases (ICD), deaths from TB among HIV-negative people are classified as TB deaths (1). When an HIV-positive person dies from TB, the underlying cause is classified as HIV with TB as a contributory cause. For consistency with international classifications, this section makes a clear distinction between TB deaths in HIV-negative people and TB deaths in HIV-positive people. The milestones and targets for reductions in TB deaths set in the End TB Strategy are for the combined total of deaths in HIV-positive and HIV-negative people.

Estimates of the number of TB deaths in 2020 should be regarded as provisional (Box 2.2.1). They suggest that the global number of TB deaths increased between 2019 and 2020: from 1.2 million (95% uncertainty interval [UI], 1.1–1.3 million) to 1.3 million (UI, 1.2–1.4 million) among HIV-negative people and from 209,000 (UI, 178,000–243,000) to 214,000 (UI, 187,000–242,000) among HIV-positive people (Table 2.2.1, Fig. 2.2.1). This is the first annual increase in the number of people dying from TB since 2005. It has been caused by disruptions to provision of and access to essential TB diagnostic and treatment services during the COVID-19 pandemic, which have resulted in an 18% reduction in the number of people reported to have been diagnosed with TB in 2020 (Section 1, Section 3). The global CFR in 2020 was 15%, up from 14% in 2019.

The impact of the COVID-19 pandemic has reversed years of global progress in reducing the number of people who die from TB, with the estimated number of deaths in 2020 back to the level of 2017 (Fig. 2.2.1). Instead of the targeted 35% reduction in the number of TB deaths between 2015 and 2020, there was a reduction of only 9.2%. Projections of TB mortality that account for the impact of the COVID-19 pandemic in 16 priority countries which accounted for 71% of the total number of people who fell ill with
TB in 2020 (including two of the top three, India and Indonesia) suggest that the global number of TB deaths could rise further in 2022 and 2023 (Section 1), in line with earlier modelling projections (5–8).

The latest year for which WHO has published estimates of global deaths by cause is 2019 (Fig. 2.2.2). These estimates showed that TB was the top cause of death from a single infectious agent and the 13th leading cause of death worldwide. In 2020, it is anticipated that TB will rank second as a cause of death from a single infectious agent, after COVID-19 (4). The estimated number of deaths officially classified as caused by TB (1.3 million) in 2020 was almost double the number caused by HIV/AIDS (0.68 million), and TB mortality was more severely impacted by the COVID-19 pandemic (Fig. 2.2.3, Fig. 2.2.4). In contrast to TB, deaths from HIV/AIDS continued to decline between 2019 and 2020 (9).

The global pattern of a fall in the TB mortality rate (TB deaths per 100,000 population per year) and in the absolute number of TB deaths until 2019, followed by an increase in 2020, was evident in four of the six WHO regions; the exceptions were the African and Western Pacific regions, where there was a flat trend (Fig. 2.2.5, Fig. 2.2.6). The WHO European Region came closest to reaching the 2020 milestone of a 35% reduction in TB deaths between 2015 and 2020, with an estimated reduction of 26%. This decline was driven by progress in the Russian Federation, where the annual number of TB deaths fell 10% per year between 2010 and 2020. The African Region made relatively good progress, with a reduction of 18%. In contrast, the number of TB deaths in 2020 was higher than in 2015 in the Americas (+10%). Declines compared with 2015 in the other WHO regions were 13% in the Western Pacific, 6.2% in the Eastern Mediterranean and 0.19% in South-East Asia.

The number of TB deaths increased in 2020 in most of the 30 high TB burden countries (Fig. 2.2.7a). Only six high TB burden countries achieved the milestone of a 35% reduction between 2015 and 2020: Kenya, Mozambique, Myanmar, Sierra Leone, the United Republic of Tanzania and Viet Nam. Of the three global TB watchlist countries, only the Russian Federation achieved the milestone (Fig. 2.2.7b), with a cumulative reduction of 42%. In total, 33 countries reached the milestone.

In 2020, about 84% of TB deaths among HIV-negative people and 85% of the combined total of TB deaths in HIV-negative and HIV-positive people occurred in the WHO African and South-East Asia regions (Table 2.2.1). India accounted for 38% of global TB deaths among HIV-negative people, and for 34% of the combined total number of TB deaths in HIV-negative and HIV-positive people. There is considerable national variation in the TB mortality rate (Fig. 2.2.8) and the CFR (Fig. 2.2.9).

Globally in 2020, 53% of the HIV-negative people who died from TB were men, 32% were women and 16% were children (aged <15 years) (Fig. 2.2.10). The higher share for children compared with their estimated share of cases (11%) suggests poorer access to diagnosis and treatment. Of the TB deaths among HIV-positive people, 50% were men, 40% were women and 9.8% were children.
Further country-specific details about estimates of the number of TB deaths and TB mortality rates are available in the Global tuberculosis report app and online country profiles.

Box 2.2.1

Methods used by WHO to estimate TB mortality

The main methods used by WHO to estimate TB mortality at country level in the period 2000–2019 and for 2020 specifically are shown in Fig. 2.2.11a and Fig. 2.2.11b. These methods adhere to global guidelines for accurate and transparent reporting of health estimates (10) and are described in detail in a technical annex.

Estimates of the number of TB deaths among HIV-negative people published by WHO in 2020 for the period 2000–2019 used data on causes of death from national vital registration (VR) systems or mortality survey data for 123 countries (Fig. 2.2.11a), which collectively accounted for 60% of the estimated number of TB deaths (among HIV-negative people) globally in 2019 (2). For 21 of these countries, analyses of VR data and resulting estimates of TB deaths published by the Institute of Health Metrics and Evaluation (IHME) were used (3). For all other countries, TB mortality among HIV-negative people was estimated as the product of TB incidence and the CFR. For all countries, TB mortality among HIV-positive people was estimated as the product of TB incidence and the CFR, with the latter accounting for the protective effect of antiretroviral treatment (ART).

To estimate the number of TB deaths in 2020, new methods were required to account for the impact of the COVID-19 pandemic (Fig. 2.2.11b). Dynamic modelling was used for 16 priority countries and a statistical model was developed to extend these modelled estimates to 76 other countries. VR data continued to be used for 87 countries. Extrapolation of the pre-2020 trend was used for 38 countries. All estimates for 2020 should be considered provisional. In addition to the need for further refinement of methods used for TB specifically, data on the total number of deaths in 2020 (including those with unknown or ill-defined causes) are required, but not yet available to WHO.
Table 2.2.1 Global and regional estimates of TB mortality, numbers (in thousands) and rates (per 100 000 population) in 2020

Low and high are the 5th and 95th percentiles of the uncertainty interval (UI).

<table>
<thead>
<tr>
<th>Region or country group</th>
<th>Number of deaths (in thousands)</th>
<th>Rate per 100 000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIV-negative Best estimate</td>
<td>HIV-positive Best estimate</td>
</tr>
<tr>
<td>African Region</td>
<td>379 321 441</td>
<td>170 144 199</td>
</tr>
<tr>
<td>Region of the Americas</td>
<td>19 18 20</td>
<td>7.9 7.2 8.7</td>
</tr>
<tr>
<td>Eastern Mediterranean Region</td>
<td>90 68 92</td>
<td>2.9 2.6 3.3</td>
</tr>
<tr>
<td>European Region</td>
<td>21 20 22</td>
<td>5.4 5.0 5.9</td>
</tr>
<tr>
<td>South-East Asia Region</td>
<td>696 600 747</td>
<td>21 19 23</td>
</tr>
<tr>
<td>Western Pacific Region</td>
<td>87 80 93</td>
<td>8.9 4.9 9.9</td>
</tr>
<tr>
<td>High TB burden countries</td>
<td>1110 1150 1190</td>
<td>106 139 134</td>
</tr>
<tr>
<td>Global</td>
<td>1280 1210 1360</td>
<td>214 187 242</td>
</tr>
</tbody>
</table>

Fig. 2.2.1 Global trends in the estimated number of TB deaths (left) and the mortality rate (right), 2000–2020

Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.
Fig. 2.2.2 Top causes of death worldwide in 2019\textsuperscript{a,b}

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

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig222.png}
\caption{Top causes of death worldwide in 2019\textsuperscript{a,b}.}
\end{figure}

\textsuperscript{a} This is the latest year for which estimates for all causes are currently available. See WHO estimates, available at https://www.who.int/infodap/topics/health-mortality-and-global-health-estimates/leading-causes-of-death.

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

Fig. 2.2.3 Estimated number of deaths from HIV/AIDS and TB in 2020\textsuperscript{a,b}

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

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig223.png}
\caption{Estimated number of deaths from HIV/AIDS and TB in 2020\textsuperscript{a,b}.}
\end{figure}

\textsuperscript{a} For HIV/AIDS, the latest estimates of the number of deaths in 2020 that have been published by UNAIDS are available at http://www.unaids.org/en (accessed 14 August 2021). For TB, the estimates for 2020 are those published in this report.

\textsuperscript{b} Deaths from TB among HIV-positive people are officially classified as deaths caused by HIV/AIDS in the International Classification of Diseases.
Fig. 2.2.4 Global trends in the estimated number of deaths caused by TB and HIV (in millions), 2000–2020\textsuperscript{a,b}

\textsuperscript{a} For HIV/AIDS, the latest estimates of the number of deaths in 2020 that have been published by UNAIDS are available at [http://www.unaids.org/en](http://www.unaids.org/en) (accessed 9 August 2021). For TB, the estimates for 2020 are those published in this report.

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

---

Fig. 2.2.5 Trends in estimated TB mortality rates by WHO region, 2000–2020

Estimated TB mortality rates among HIV-negative people are shown in blue and estimated mortality rates among HIV-positive people are shown in light blue. Shaded areas represent uncertainty intervals.
Fig. 2.2.6 Trends in the estimated absolute number of TB deaths (HIV-positive and HIV-negative) by WHO region, 2000–2020

Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.
Fig. 2.2.7a Trends in the estimated absolute number (in thousands) of TB deaths (HIV-positive and HIV-negative TB) in the 30 high TB burden countries, 2000–2020

Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2003 milestone of the End TB Strategy.

Fig. 2.2.7b Trends in the estimated absolute number (in thousands) of TB deaths (HIV-positive and HIV-negative TB) in the 3 global TB watchlist countries, 2000–2020

Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.
Fig. 2.2.8 Estimated TB mortality rates in HIV-negative people, 2020

Fig. 2.2.9 Estimates of the case fatality ratio (CFR), including HIV-negative and HIV-positive people, 2020
Fig. 2.2.10a Global distribution of estimated TB mortality in HIV-negative people by age group and sex (female in purple; male in green), 2020.

Fig. 2.2.10b Regional distribution of estimated TB mortality in HIV-negative people by age group and sex (female in purple; male in green), 2020.
**Fig. 2.2.11a** Main methods used to estimate TB mortality in HIV-negative people up to 2019


**Fig. 2.2.11b** Main methods used to estimate TB mortality in HIV-negative people in 2020

VR: Vital registration of causes of death
References

2.3 National TB prevalence surveys

To reliably track the burden of tuberculosis (TB) disease in terms of TB incidence and TB mortality from subnational to global levels, the ultimate goal is that all countries can rely on data routinely collected through national disease surveillance and vital registration (VR) systems. Currently, all countries have national systems for notification (i.e. reporting) of TB cases and most report national notification data to the World Health Organization (WHO) on an annual basis (Section 3). However, in many countries (including most high TB burden countries) the number of notified cases each year is not a good proxy for the actual number of people who develop TB disease, for two reasons. The first is underreporting of people diagnosed with TB, especially in countries with large private sectors or in which people with TB seek care in public facilities that are not linked to the national TB programme and its associated reporting systems. The second is underdiagnosis, especially in countries with geographic or financial barriers to seeking health care. Many countries (including most high TB burden countries) do not have established national VR systems of high quality and coverage that can be used to reliably monitor the number of deaths and their cause (1).

In countries with a relatively high burden of TB disease that do not yet have national disease notification and VR systems of sufficiently high quality and coverage, national TB prevalence surveys are the best way to directly measure the burden of TB disease in the population (2, 3, 4). In terms of disease burden, WHO currently recommends consideration of surveys in countries with an estimated TB incidence of ≥150 per 100,000 population per year (3, 4).

National TB prevalence surveys can provide a reliable measurement of the number of people in the population with bacteriologically confirmed pulmonary TB at a given point in time, and the distribution of these cases by age and sex. In addition, repeat surveys allow assessment of trends, and of the impact of interventions to reduce the burden of disease in the period since the last survey. WHO recommends that surveys focus on people aged 15 years or over (2). Results can be used to inform national estimates of TB incidence in all age groups, and can thus help to track progress towards the milestones and targets for reductions in TB incidence set in the End TB Strategy (Section 2.1, Fig. 2.1.8a). Previously, survey results were also important for the assessment of progress towards global, regional and national targets for reductions in TB prevalence between 1990 and 2015.

For these reasons, the implementation of national TB prevalence surveys in 22 priority countries (referred to as global focus countries, GFCs) was one of three strategic areas of work defined by the WHO Global Task Force on TB Impact Measurement (the Task Force) for the period 2007–2015 (2, 3). National TB prevalence surveys were retained as one of the Task Force’s strategic areas of work after 2015 (4, 5).
Other benefits of prevalence surveys include that they can be used to document health care seeking behaviour in the public and private sectors, assess variation in underreporting or underdiagnosis of TB by age and sex (using the ratio of prevalence to notifications), and quantify the extent of underreporting of people diagnosed with TB to national authorities. Findings can help to inform the development or improvement of TB case finding, diagnosis and treatment interventions.

Countries in which national prevalence surveys were implemented in 2000–2021 or are planned to start in 2022 are shown in Fig. 2.3.1 and Fig. 2.3.2. Between 2007 and the end of 2019, a total of 33 surveys that used the screening and diagnostic methods recommended by WHO (2) were completed in 30 countries (with repeat surveys in Myanmar, the Philippines and Viet Nam). These 30 countries comprised 17 in Africa and 13 in Asia, and 20 of the 22 GFCs. No surveys were completed in 2020, with the first national TB prevalence survey in India delayed by the COVID-19 pandemic. However, as of August 2021, the field operations of the survey in India were ongoing and scheduled for completion by the end of the year. The survey is one of the largest ever undertaken, with a planned sample size of about 500 000 people. Preparations for repeat surveys in Cambodia and Pakistan are underway.

Surveys showed that the estimated prevalence of bacteriologically confirmed pulmonary TB per 100 000 population aged 15 years or over was high in many countries, but there was also considerable variation (Fig. 2.3.3). In African countries, prevalence ranged from 119 (95% confidence interval [CI]: 79–160) per 100 000 population in Rwanda (in 2012) to 852 (95% CI: 679–1026) per 100 000 population in South Africa (in 2017). In Asian countries, prevalence ranged from 119 (95% CI: 103–135) per 100 000 population in China (in 2010) to 1159 (95% CI: 1016–1301) per 100 000 population in the Philippines (in 2016).

In most Asian countries and some African countries, prevalence increased with age (Fig. 2.3.4, Fig. 2.3.5). As transmission declines, more incident cases arise from past rather than recent infection. Therefore, a pattern in which prevalence increases with age suggests that transmission is falling. It is encouraging that prevalence surveys indicated that transmission is potentially declining in many Asian countries and in several African countries (e.g. Ghana, Lesotho, Malawi, Mozambique, Rwanda and the United Republic of Tanzania). Elsewhere, surveys suggested considerable community transmission; peaks in many African countries in the age groups 35–44 or 45–54 years also reflect the impact of the HIV epidemic.

A striking finding across all surveys was the much higher burden of TB disease in men compared with women (Fig. 2.3.6). The male to female (M:F) ratio of bacteriologically confirmed pulmonary cases in surveys completed in 2007–2019 ranged from 1.2 (in Ethiopia) to 4.5 (in Viet Nam); in most countries it was in the range 2–4. These findings mean that men typically account for about 66–75% of the burden of TB disease in adults.
Ratios of prevalence to notifications (P:N, expressed in years) suggest marginally higher detection and reporting gaps in Asia compared with Africa, and lower detection and reporting gaps among women compared with men (Fig. 2.3.7, Fig. 2.3.8). The combination of a higher disease burden in men and larger gaps in detection and reporting indicates a need for strategies to improve access to and use of health services among men (6).

A WHO 2021 publication provides full details about the results and lessons learned from the 25 national surveys implemented in 2007–2016 (3). In addition, regional syntheses of survey results and lessons learned are available in journal articles (7, 8).

A third edition of the WHO handbook on national TB prevalence surveys is in development and is scheduled for completion in 2022.
The measured prevalence of bacteriologically confirmed pulmonary TB was higher in the 2017 survey in Viet Nam compared with 2007. However, this was due to more diagnostic testing with more sensitive methods. When results based on the same method were compared, prevalence was estimated to have fallen between 2007 and 2017.
Surveys in Gambia and Rwanda were restricted to only three age group categories because the number of survey cases was low. Bacteriologically confirmed TB cases could not be verified for United Republic of Tanzania, so smear-positive TB prevalence rates are shown instead.
Fig. 2.3.5 Estimated age-specific prevalence of bacteriologically confirmed pulmonary TB for surveys implemented in Asia, 2007–2019
Fig. 2.3.6 The male to female ratio of bacteriologically confirmed adult TB cases detected in prevalence surveys implemented 2007–2020\textsuperscript{a}

\textsuperscript{a} Due to laboratory challenges during the survey in United Republic of Tanzania, it was only possible to directly estimate the prevalence of smear-positive (as opposed to bacteriologically confirmed TB).

---

39
Fig. 2.3.7 The prevalence to notification (P:N) ratio of adult TB cases in prevalence surveys implemented 2007–2020

* The P:N ratio is for smear-positive TB, except for Bangladesh, Democratic People’s Republic of Korea, Kenya, Myanmar (2016), Namibia (2018), Uganda, Viet Nam (2017) and Zimbabwe where it was based on bacteriologically confirmed TB. Prevalence estimates are from a cross-sectional survey, and therefore only represent one point in time. Notification data are from the main year of the survey.

Fig. 2.3.8 The prevalence to notification (P:N) ratio by sex for adult TB cases in prevalence surveys implemented 2007–2020

* The P:N ratio is for smear-positive TB, except for Bangladesh, Democratic People’s Republic of Korea, Kenya, Myanmar (2016), Namibia (2018), Uganda, Viet Nam (2017) and Zimbabwe where it was based on bacteriologically confirmed TB. Prevalence estimates are from a cross-sectional survey, and therefore only represent one point in time. Notification data are from the main year of the survey.
References


3. TB diagnosis and treatment

3.1 Case notifications

Prompt and accurate diagnosis followed by provision of treatment according to international standards prevents deaths and limits ill health among people who develop tuberculosis (TB). It also prevents further transmission of infection to others. The 2020 and 2025 milestones for reductions in TB incidence and TB deaths set in the World Health Organization (WHO) End TB Strategy require the case fatality ratio (i.e. the proportion of people with TB who die from the disease) to fall to 10% by 2020 and 6.5% by 2025. The latter is only feasible if all people with TB are diagnosed promptly and treated effectively. Patient-centred care and prevention – backed by bold policies and supportive systems such as universal health coverage (UHC) and social protection – are Pillars 1 and 2 of the End TB Strategy.

The political declaration at the first United Nations (UN) high-level meeting on TB in 2018 included targets to diagnose and treat 40 million people with TB (including 3.5 million children) in the 5-year period 2018–2022, and 1.5 million people with drug-resistant TB (DR-TB, including 115 000 children).

Data on the number of people diagnosed with TB, based on standard case definitions and associated guidance on the recording and reporting of data provided by WHO, have been systematically collected at national level and then reported to WHO on an annual basis since the mid-1990s (1-3). These case notification data can be used to monitor the number of people diagnosed with TB and officially reported through national disease surveillance systems and to track progress towards global targets for TB detection and treatment. Comparisons with estimates of TB incidence (Section 2.1) can be used to assess gaps in detection and treatment of people with TB.

Disruptions to the provision of and access to TB diagnostic and treatment caused by the COVID-19 pandemic have had a major negative impact on the number of people diagnosed and reported with TB. Globally in 2020, 5.8 million people with a new episode of TB (new and relapse cases) were diagnosed and notified (Table 3.1), a substantial fall of 18% from 7.1 million in 2019 (Fig. 3.1.1). Downturns between 2019 and 2020 were evident in all six WHO regions (Fig. 3.1.1), although the reduction in the African Region was relatively modest (2.5%). The largest reductions in absolute terms were in the WHO regions of South-East Asia and the Western Pacific, reflecting particularly large falls in notifications in high TB burden countries such as the Philippines (37%), Indonesia (31%) and India (25%) (Fig. 3.1.2). Two of these countries – India and Indonesia – had previously been the main contributors to large increases in global TB notifications between 2013 and 2019 (their combined annual total number of notifications increased by 1.2 million in that period).

The cumulative total number of people diagnosed with TB and officially reported from 2018 to 2020 is 19.8 million, only 50% of the 5-year target of 40 million. With disruptions caused by the COVID-19
pandemic continuing in 2021 (Section 1), the target of 40 million is off track (Fig. 3.1.3). The target for detection and treatment of people with DR-TB appears even further out of reach (Fig. 3.1.3). A total of 157,903 people with DR-TB were diagnosed and notified in 2020, including 132,222 with multidrug-resistant or rifampicin-resistant (MDR/RR-TB) and 25,681 with pre-extensively drug-resistant TB (pre-XDR-TB) or XDR-TB (Table 3.1). This was a 22% reduction from 201,997 in 2019. A total of 150,359 people were reported to have been enrolled on treatment in 2020 (further details in Section 3.4).

Most notified cases are among adults (Fig. 3.1.4), with more of those cases among men than women (Fig. 3.1.5). Of the global total of new and relapse TB cases notified in 2020, 58% were men, 35% were women and 7% were children (aged <15 years). A total of 1.4 million children were diagnosed and notified from 2018 to 2020, only 41% of the 5-year global target (for 2018–2022) of 3.5 million (Fig. 3.1.3). Between 2019 and 2020, there was a 24% decrease in notifications of TB cases among children, from 523,820 to 399,107. The global male:female (M:F) ratio for notifications in 2020 was 1.6, but ranged across WHO regions from 1.1 (WHO Eastern Mediterranean Region) to 2.0 (Western Pacific Region).

In the WHO regions of the Eastern Mediterranean, South-East Asia and Western Pacific, the TB epidemic is a markedly ageing one, with a progressive increase in the notification rate with age, and a peak among those aged 65 years or over (Fig. 3.1.5). Elsewhere, notification rates were highest among adults aged 45–54 years in the WHO African Region, 25–34 years in the WHO Region of the Americas and 35–44 years in the WHO European Region.

Variation among regions and countries in the proportion of notified cases among children (Fig. 3.1.5, Fig. 3.1.6), in the M:F ratios of cases (Fig. 3.1.5) and in the proportions diagnosed with pulmonary or extrapulmonary TB (Table 3.1, Fig. 3.1.7) may reflect real differences in epidemiology, differential access to or use of health care services, or differential diagnostic and reporting practices. In general, notification data appear to underestimate the share of the TB disease burden accounted for by men, since higher M:F ratios among adults have been found in national TB prevalence surveys (see Section 2.3 for further details). There are recognized issues with the diagnosis and reporting of TB in children, including the use of variable case definitions and underreporting of cases diagnosed by paediatricians in the public and private sectors. Greater attention to the quality of TB notification data for children is warranted in many countries.

Globally in 2020, there was a large global gap of more than 4 million between the number of people newly diagnosed with TB in 2020 and the estimated number of incident cases, which was also wider compared with 2019 (Fig. 3.1.1). This gap is due to underreporting of detected cases and underdiagnosis (if people with TB cannot access health care or are not diagnosed when they do access it).
Engagement of all care providers in the public and private sectors through public–private mix (PPM) initiatives can help to minimize the underreporting of people diagnosed with TB. Seven countries have been defined as top global priorities for PPM (4), and the contribution of PPM to total notifications of TB cases has grown in most of those countries since 2015 (Fig. 3.1.8). Community engagement can help with referrals of people with TB symptoms to health facilities as well as treatment support; in 81 countries from which WHO requested data in 2020, such engagement was reported in a high proportion of basic management units (Fig. 3.1.9).

Gaps between notifications and estimates of TB incidence, especially in the 10 countries that account for most of the global gap, are discussed further in Section 3.3.

Ideally, data for people diagnosed with TB should be captured in digital case-based surveillance systems and reported in close to real time. As of August 2020, 130 countries had a digital case-based surveillance system that covered all TB cases (both drug-susceptible TB and DR-TB) (Fig. 3.1.10). These countries accounted for 66% of global TB notifications in 2020. The global status of progress towards digital case-based surveillance is covered in more detail in the featured topics section of this report.

Further country-specific details about TB notifications are available in the Global tuberculosis report app and country profiles.
### Table 3.1 Notifications of TB, HIV-positive TB, MDR/RR-TB and XDR-TB cases, globally and for WHO regions, 2020

<table>
<thead>
<tr>
<th>WHO region</th>
<th>Total notified</th>
<th>New and relapse(^a)</th>
<th>Pulmonary new and relapse number</th>
<th>Pulmonary new and relapse bacteriologically confirmed (%)</th>
<th>Extrapulmonary new and relapse (%)</th>
<th>HIV-positive new and relapse</th>
<th>MDR/RR-TB only(^b)</th>
<th>pre-XDR-TB or XDR-TB(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>African Region</td>
<td>1 401 351</td>
<td>1 365 224</td>
<td>1 164 508</td>
<td>65%</td>
<td>15%</td>
<td>271 956</td>
<td>17 212</td>
<td>1 243</td>
</tr>
<tr>
<td>Region of the Americas</td>
<td>2 066 614</td>
<td>1 866 698</td>
<td>1 677 365</td>
<td>77%</td>
<td>14%</td>
<td>166 824</td>
<td>3 726</td>
<td>210</td>
</tr>
<tr>
<td>South-East Asia Region</td>
<td>2 707 444</td>
<td>2 560 817</td>
<td>1 854 335</td>
<td>50%</td>
<td>24%</td>
<td>53 380</td>
<td>55 296</td>
<td>9 672</td>
</tr>
<tr>
<td>European Region</td>
<td>1 195 701</td>
<td>1 195 701</td>
<td>1 326 337</td>
<td>67%</td>
<td>17%</td>
<td>19 466</td>
<td>25 979</td>
<td>12 626</td>
</tr>
<tr>
<td>Eastern Mediterranean Region</td>
<td>420 015</td>
<td>423 485</td>
<td>320 636</td>
<td>55%</td>
<td>24%</td>
<td>1 352</td>
<td>3 406</td>
<td>897</td>
</tr>
<tr>
<td>Western Pacific Region</td>
<td>1 141 563</td>
<td>1 119 817</td>
<td>1 029 204</td>
<td>55%</td>
<td>8%</td>
<td>13 185</td>
<td>26 537</td>
<td>1 633</td>
</tr>
<tr>
<td><strong>Global</strong></td>
<td><strong>6 143 868</strong></td>
<td><strong>5 824 745</strong></td>
<td><strong>4 759 836</strong></td>
<td><strong>59%</strong></td>
<td><strong>18%</strong></td>
<td><strong>375 963</strong></td>
<td><strong>132 222</strong></td>
<td><strong>25 681</strong></td>
</tr>
</tbody>
</table>

\(^a\) Total and relapse include cases for which the treatment history is unknown. It includes cases that have been re-registered as treatment after failure, as non-patient after loss to follow up or as other previously treated (where outcome after the most recent course of treatment is unknown or underestimated).

\(^b\) TB that is resistant to at least rifampicin, excluding any cases with known resistance to any fluoroquinolone.

\(^c\) pre-XDR-TB is TB that is resistant to isoniazid and to any fluoroquinolone. XDR-TB is TB that is resistant to isoniazid and to any fluoroquinolone and to at least one of bedaquiline or linezolid.

---

### Fig. 3.1.1 Notifications of people newly diagnosed with TB (new and relapse cases, all forms) (black) compared with estimated TB incident cases (green), 2000–2020, globally and for WHO regions

Unshaded areas represent uncertainty intervals.
Fig. 3.1.2 Notifications of people newly diagnosed with TB (new and relapse cases, all forms) (black) compared with estimated TB incident cases (green), 2000–2020, 30 high TB burden countries.
Fig. 3.1.3 Global progress in the number of people treated for TB between 2018 and 2020, compared with cumulative targets set for 2018–2022 at the UN high-level meeting on TB.

**TB treatment (All ages)**
- Target: 40 million 2018–2022
- Treated in 2018–2020: 19.8 million (50%)

**TB treatment (Children)**
- Target: 3.5 million 2018–2022
- Treated in 2018–2020: 1.4 million (41%)

**MDR/RR-TB treatment (All ages)**
- Target: 1.5 million 2018–2022
- Treated in 2018–2020: 483,000 (32%)

**MDR/RR-TB treatment (Children)**
- Target: 115,000 2018–2022
- Treated in 2018–2020: 12,200 (11%)

---

Fig. 3.1.4 The global number of people reported to have been treated for TB disease, 2015–2020.

- Adults aged 15 and above
- Children aged under 15
**Fig. 3.1.5** Estimated TB incidence (black outline) and new and relapse TB case notification rates by age group and sex\(^\text{a}\) (female in purple; male in green) in 2020, globally and for WHO regions.

\(^\text{a}\) Data from 36 countries and areas that did not report cases in these age categories are excluded. Cases included accounted for 96% of reported cases.

**Fig. 3.1.6** Percentage of new and relapse TB cases that were children (aged <15 years), 2020.
Fig. 3.1.7 Percentage of extrapulmonary cases among new and relapse TB cases, 2020

Fig. 3.1.8 Contribution of public-private mix to TB case notifications in priority countries, 2010–2020
Fig. 3.1.9 Percentage of basic management units in which there was community contribution to new case finding and/or to treatment adherence support. 2020

Fig. 3.1.10 Countries with national case-based digital surveillance systems for TB, 2020

References

3.2 Diagnostic testing for TB, HIV-associated TB and drug-resistant TB

An essential step in the pathway of tuberculosis (TB) care is rapid and accurate testing to diagnose TB. In recent years, nucleic-acid amplification tests (NAATs), which are highly specific and sensitive, have helped to revolutionize the TB diagnostic landscape. Line-probe assays were the first molecular tests recommended by the World Health Organization (WHO). They significantly reduce the time needed to diagnose multidrug-resistant and rifampicin-resistant TB (MDR/RR-TB), compared with culture testing. The next major step forward was the WHO endorsement of the Xpert MTB/RIF assay in 2010. Along with the next-generation Xpert Ultra assay, this has substantially improved the diagnosis of TB and RR-TB compared with sputum smear microscopy, including at peripheral levels of the health system.

The number of new NAATs recommended by WHO has steadily grown. In the latest guideline update (1), three additional classes of tests were added as initial tests for the diagnosis of TB and simultaneous detection of resistance to both rifampicin and isoniazid. Follow-on tests for the rapid diagnosis of second-line resistance were also recommended. Among the latter, the low-complexity automated NAATs are recommended, since they enable rapid and decentralized testing for resistance to fluoroquinolones (a class of second-line anti-TB drug), isoniazid, ethionamide and amikacin. For the first time, a molecular test for pyrazinamide resistance has also been recommended. To date, more than ten NAATs have been recommended.

People diagnosed with TB using culture, rapid molecular tests recommended by WHO or sputum smear microscopy are defined as “bacteriologically confirmed” cases of TB (2).

The microbiological detection of TB is critical because it allows people to be correctly diagnosed and started on the most effective treatment regimen as early as possible. People diagnosed with TB in the absence of bacteriological confirmation are classified as “clinically diagnosed” cases of TB. Most clinical features of TB and abnormalities on chest radiography or histology results generally associated with TB have low specificity; thus, a proportion of clinically diagnosed cases may be incorrect diagnoses of TB. In many countries, there is a need to increase the percentage of cases confirmed bacteriologically by scaling up the use of WHO-recommended rapid diagnostics, which are much more sensitive than sputum smear microscopy, in line with WHO guidelines (1). Given the links between HIV infection and TB disease, HIV testing of people diagnosed with TB has been part of WHO guidance on collaborative TB/HIV activities since 2004 (3).

Bacteriological confirmation of TB is necessary to test for resistance to first-line and second-line anti-TB drugs; such testing can be done using rapid molecular tests, phenotypic susceptibility testing or reference-level genetic sequencing (2). Five categories are used to classify cases of drug-resistant TB:
isoniazid-resistant TB, RR-TB, MDR-TB, pre-extensively drug-resistant TB (pre-XDR-TB) and XDR-TB. MDR-TB is TB that is resistant to both rifampicin and isoniazid, the two most powerful first-line anti-TB drugs. Pre-XDR-TB is TB that is resistant to rifampicin and to any fluoroquinolone. XDR-TB is TB that is resistant to rifampicin as well as any fluoroquinolone and to at least one of the drugs bedaquiline and linezolid.

All forms of drug-resistant TB (DR-TB) require treatment with a second-line regimen (4). The WHO End TB Strategy calls for universal access to drug susceptibility testing (DST).

Of the global total of 5.8 million people newly diagnosed with TB and officially notified as a TB case in 2020, 4.8 million (82%) had pulmonary TB. Among these 4.8 million, 59% were bacteriologically confirmed (Table 3.1.1); this was a slight increase from 57% in 2019, but the percentage has remained virtually unchanged since 2005 (Fig. 3.2.1). There is some variation among the six WHO regions, with the highest percentage of people diagnosed with pulmonary TB who were bacteriologically confirmed in 2020 achieved in the Region of the Americas (77%) and the lowest in the Western Pacific Region (55%). There is considerable variation among countries (Fig. 3.2.2, Fig. 3.2.3, Fig. 3.2.4). In general, levels of confirmation are lower in low-income countries and highest in high-income countries (median, 81%), where there is wide access to the most sensitive diagnostic tests. Reliance on direct smear microscopy alone is inherently associated with a relatively high proportion of unconfirmed pulmonary TB cases.

In the 30 high TB burden countries, differences in diagnostic and reporting practices are the likely cause of variation in the proportion of pulmonary cases that are bacteriologically confirmed. In 2020, the percentage ranged from 35% in Mozambique to at least 75% in Bangladesh, the Democratic Republic of the Congo, Liberia, Mongolia, Namibia and Nigeria (Fig. 3.2.2). The low value following a large fall over a period of several years in Mozambique is of particular concern, as are the downward trends observed since about 2016–2017 in India, Indonesia, Uganda and the United Republic of Tanzania. When the proportion of people diagnosed with pulmonary TB based on bacteriological confirmation falls below 50%, a review of the diagnostic tests in use and the validity of clinical diagnoses is warranted (e.g. via a clinical audit).

Globally in 2020, a WHO-recommended rapid molecular test was used as the initial diagnostic test for 1.9 million (33%) of the 5.8 million people newly diagnosed with TB in 2020, up from 28% in 2019. There was substantial variation among countries (Fig. 3.2.5). Among the 49 countries in one of the three global lists of high burden countries (for TB, HIV-associated TB and MDR/RR-TB) being used by WHO in the period 2021–2025 (Annex 3 of the main report), 21 reported that a WHO-recommended rapid diagnostic test had been used as the initial test for more than half of their notified TB cases, up from 18 in 2019.
Of the 5.8 million people newly diagnosed with TB globally in 2020, 73% had a documented HIV test result, up from 70% in 2019 (Fig. 3.2.6). At regional level, the highest percentages were achieved in the WHO African and European regions (Fig. 3.2.6), at 85% and 93%, respectively. There was considerable variation at national level (Fig. 3.2.7). In 87 countries and territories, at least 90% of people diagnosed with TB knew their HIV status. In most countries, the percentage was above 50%, but in a small number of countries it is still the case that fewer than half of the people diagnosed with TB know their HIV status. Worldwide, a total of 375 963 cases of TB among people living with HIV were notified in 2020 (Table 3.1.1), equivalent to 9.0% of the 4.2 million people diagnosed with TB who had an HIV test result. Overall, the percentage of people diagnosed with TB who had an HIV-positive test result has fallen globally over the past 10 years.

Globally in 2020, 71% of people diagnosed with bacteriologically confirmed pulmonary TB were tested for rifampicin resistance, up from 61% in 2019 and 50% in 2018, with considerable variation among countries (Fig. 3.2.8, Fig. 3.2.9). Among these, 132 222 cases of MDR/RR-TB and 25 681 cases of pre-XDR-TB or XDR-TB were detected (Table 3.1.1), for a combined total of 157 903. This was a large fall (22%) from the total of 201 997 in 2019 and is consistent with the similarly large reduction (18%) in the total number of people who were newly diagnosed with TB between 2019 and 2020 (Section 3.1).

Improvements in the coverage of testing for rifampicin resistance were made in all six WHO regions between 2019 and 2020, with the highest level in 2020 (93%) being achieved in the European Region (Fig. 3.2.8). The WHO regions where there is the greatest need for increases in coverage of testing for rifampicin resistance are the African Region and the Region of the Americas (both were around 50% in 2020).

Of the 30 high MDR/RR-TB burden countries, 18 reached coverage of testing for rifampicin resistance of more than 80% in 2020: Azerbaijan, Belarus, China, India, Kazakhstan, Kyrgyzstan, Mongolia, Myanmar, the Philippines, the Republic of Moldova, the Russian Federation, South Africa, Tajikistan, Ukraine, Uzbekistan, Viet Nam, Zambia and Zimbabwe.

The global, regional and national coverage of testing for resistance to fluoroquinolones was much lower (Fig. 3.2.10, Fig. 3.2.11) at just over 50% worldwide, and was lower still (not much above 25%) in the WHO regions of the Americas, South-East Asia and the Western Pacific. The highest levels of regional and national coverage were achieved in the WHO European Region.

Further country-specific details about diagnostic testing for TB, HIV-associated TB and anti-TB drug resistance are available in the Global tuberculosis report app and country profiles.
Fig. 3.2.1 Percentage of new and relapse pulmonary TB cases with bacteriological confirmation, globally and for WHO regions,\(^2\) 2000–2020

\(^2\) The calculation for new and relapse pulmonary cases in years prior to 2013 is based on smear results, except for the European Region where data on confirmation by culture was also available for the period 2002–2012.
Fig. 3.2.2 Percentage of new and relapse pulmonary TB cases with bacteriological confirmation, 2000–2020, 30 high TB burden countries
**Fig. 3.2.3** Percentage of new and relapse pulmonary TB cases with bacteriological confirmation, 2020

**Fig. 3.2.4** Distribution of the proportion of notified pulmonary cases that were bacteriologically confirmed in 2020, by country income group

Boxes indicate the first, second (median) and third quartiles weighted by a country’s number of pulmonary cases; vertical lines extend to the minimum and maximum values. Countries with less than 100 cases are excluded.
Fig. 3.2.5 Percentage of new and relapse TB cases initially tested with a WHO-recommended rapid diagnostic test, 2020

Fig. 3.2.6 Percentage of new and relapse TB cases\(^a\) with documented HIV status, 2004–2020, globally and for WHO regions\(^b\)

\(^a\) The calculation is for all cases in years prior to 2016.

\(^b\) Countries were excluded if the number with documented HIV status was not reported to WHO.
Fig. 3.2.7 Percentage of new and relapse TB cases with documented HIV status, 2020

Fig. 3.2.8 Percentage of bacteriologically confirmed TB cases tested for RR-TB\(^2\), globally and for WHO regions, 2009–2020

\(^2\) Includes both new and previously treated cases; data for 2017 onwards are for pulmonary cases only.
Fig. 3.2.9 Percentage of bacteriologically confirmed TB cases tested for RR-TB, 2 2020

Fig. 3.2.10 Percentage of MDR/RR-TB cases tested for susceptibility to fluoroquinolones, 2020

2 Includes both new and previously treated cases; data are for pulmonary cases only.
Fig. 3.2.11 Percentage of MDR/RR-TB cases tested for susceptibility to fluoroquinolones\(^3\), globally and for WHO regions, 2015–2020

\(^3\) Testing in years prior to 2019 also included susceptibility to second-line injectables.

References

3.3 TB treatment and treatment coverage

Without treatment, the death rate from tuberculosis (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 people 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 (1). With TB treatment, most people who develop TB can be cured.

Effective drug treatments for TB were first developed in the 1940s. The composition of TB treatment regimens has changed over time and the currently recommended standard of care for people with drug-susceptible TB disease is a 6-month regimen of four first-line drugs: isoniazid, rifampicin, ethambutol and pyrazinamide (2). New evidence reviewed in meetings of WHO guideline development groups held in 2021 supports the use of two new 4-month treatment regimens for drug-susceptible TB that can be used as possible alternatives to the current standard 6-month regimen. Treatment for people diagnosed with drug-resistant TB (Section 3.4) requires regimens that include second-line drugs. These are longer, more expensive (≥US$ 1000 per person) and may cause more adverse events (3).

To minimize the ill health and mortality caused by TB, everyone who develops TB disease needs to be able to promptly access diagnosis and treatment. Providing TB diagnosis and treatment within the broader context of progress towards universal health coverage (UHC) is a key component of the WHO End TB Strategy, and is necessary to reach strategy milestones and targets for reductions in TB incidence and mortality (Section 2, Section 6). For example, reaching the 2025 milestone of a 75% reduction in the number of TB deaths compared with 2015 requires reducing the case fatality ratio (CFR; the percentage of people who develop TB that die from the disease) to 6.5%, which is only feasible if everyone who develops TB can access treatment. TB treatment coverage is one of the priority indicators for monitoring progress in implementing the End TB Strategy, with a recommended target of at least 90% by 2025 at the latest (4). TB treatment coverage is also one of 16 indicators used to assess progress towards the UHC target that has been set as part of the United Nations (UN) Sustainable Development Goals (SDGs) (5).

TB treatment coverage can be estimated as the number of new and relapse cases detected and treated in a given year, divided by the estimated number of incident TB cases in the same year, expressed as a percentage. Numbers of notified new and relapse cases (Section 3.1) are currently used as the numerator for the indicator, because these are the data available. However, limitations with this numerator are that there are people with TB who are treated but not notified to national authorities (and in turn are not notified to WHO) and people who are notified but who may not be started on treatment.
Anyone with TB who is living with HIV should be provided with antiretroviral treatment (ART) as well as TB treatment; thus, for this group it is also relevant to assess the coverage of ART.

Globally in 2020, TB treatment coverage was 59% (95% uncertainty interval [UI]: 53–66%) (Fig. 3.3.1), down from 72% (UI: 65–80%) in 2019. Among the six WHO regions, treatment coverage was highest in Europe (with a best estimate of 69%) and lowest in the Eastern Mediterranean (with a best estimate of 52%). Of the 30 high TB burden countries, those with the highest levels of treatment coverage in 2020 included Brazil, China and Thailand (Fig. 3.3.1). The high value for Mozambique may reflect some overdiagnosis of cases that is inflating the numerator used in the estimation of treatment coverage; in 2020, only 35% of pulmonary cases were bacteriologically confirmed (Section 3.2). Nine high TB burden countries had worryingly low levels of treatment coverage in 2020, with best estimates of below 50%: Central African Republic, Gabon, Indonesia, Lesotho, Liberia, Mongolia, Nigeria, Pakistan and the Philippines.

In 2020, there was a big increase in the global gap between the number of people newly diagnosed and reported with TB and the number of people estimated to have developed TB. This reflects the sharp fall (of 18%) in the number of people newly diagnosed and reported with TB between 2019 and 2020 (from 7.1 million to 5.8 million) that has been associated with major disruptions to provision of and access to essential TB diagnostic and treatment services during the COVID-19 pandemic (Section 1). Ten countries accounted for 74% of the total estimated global gap between incidence and notifications in 2020 (Fig. 3.3.2), with India (24%), Indonesia (11%), the Philippines (8.3%), Nigeria (7.8%) and Pakistan (7.4%) accounting for more than half the global total.

The main reasons for a gap between notifications of people reported as newly diagnosed with TB and estimated TB incidence are:

- underreporting of detected TB cases – in many countries, levels of underreporting may be high; this is especially the case for those countries that lack policies on mandatory notification and other measures to ensure reporting of detected cases by all care providers; and
- underdiagnosis of people with TB – this can occur for reasons such as poor geographical and financial access to health care; delays in seeking health care because of lack of symptoms or symptoms not being perceived as serious enough to warrant a visit to a health facility; failure to test for TB when people do present to health facilities; and use of diagnostic tests that are not sufficiently sensitive or specific to ensure accurate identification of all people with TB.

It is also possible that the gap could be underestimated due to overdiagnosis, especially in settings where a relatively low proportion of TB cases are bacteriologically confirmed (Section 3.2).

Some of the countries with the largest estimated gaps between notifications and TB incidence already possess good evidence about the reasons for such gaps, and before the COVID-19 pandemic had
achieved success in closing these gaps. For example, following studies that showed high levels of underreporting, India and Indonesia introduced policies on mandatory notification of TB cases, intensified engagement with care providers not yet reporting to national authorities, and established digital data systems to facilitate and simplify the reporting of cases. From 2013 to 2019 in India and from 2015 to 2019 in Indonesia, these actions resulted in marked increases in TB notifications (Section 3.1, Fig. 3.1.2).

An example of a country where underdiagnosis is a major challenge is Nigeria. The 2012 national TB prevalence survey found that 75% of the people with smear-positive pulmonary TB who were detected had symptoms that met national screening criteria but had not been previously diagnosed. This demonstrated a need to strengthen access to high-quality screening, diagnostic and treatment services. National TB prevalence surveys in many countries in Africa and Asia have also shown that detection and reporting gaps are systematically higher for men than for women (Section 2.3), suggesting that specific efforts are needed to improve access to TB diagnosis and treatment for men.

The global coverage of ART among people living with HIV who were also diagnosed and reported with TB was 88% in 2020, the same as the level in 2019 (Fig. 3.3.3). However, when compared with the estimated number of people living with HIV who developed TB in 2020, coverage was much lower (Fig. 3.3.4): the global average was 42%, down from 49% in 2019. Both figures were considerably worse than the overall coverage of ART for people living with HIV, which was 73% at the end of 2020 (6). The main reason for relatively low ART coverage among HIV-positive people with TB in 2020 was the big gap between the estimated number of people living with HIV who developed TB in 2020 and the number who were detected in 2020. Among the 30 high TB/HIV burden countries, best estimates of coverage varied widely, from 2.2% in Gabon to 79% in Mozambique, and only 13 of these 30 countries achieved coverage of at least 50% (Fig. 3.3.4).

Globally in 2019 (the latest annual patient cohort for which data are available), the treatment success rate for people treated for TB with first-line regimens was 86%, and ranged among WHO regions from 74% in the Americas to 91% in the Eastern Mediterranean (Fig. 3.3.5). This high level of overall treatment success has been sustained over a period of several years (Fig. 3.3.6). Treatment success rates remain lower among people living with HIV (77% globally in 2019), although there have been steady improvements over time (Fig. 3.3.6, Fig. 3.3.7). The treatment success rate for children (aged 0–14 years) was 88% in 2019 (Fig. 3.3.8). Treatment success rates have been maintained as the absolute number of people enrolled on treatment has grown (Fig. 3.3.9).

TB treatment and provision of ART to HIV-positive people diagnosed with TB are estimated to have averted 66 million deaths between 2000 and 2020 (Table 3.3.1). Country-specific details about TB treatment and treatment coverage are available in the Global tuberculosis report app and country profiles.
Fig. 3.3.1 Estimated TB treatment coverage (new and relapse patients as a percentage of estimated TB incidence) in 2020, 30 high TB burden countries, WHO regions and globally
**Fig. 3.3.2** The ten countries with the largest gaps between notifications of new and relapse (incident) TB cases and the best estimates of TB incidence, 2020

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

**Fig. 3.3.3** Estimated global number of incident HIV positive TB cases (red) compared with the global number of notified new and relapse TB cases known to be HIV-positive (black) and the global number of TB patients started on antiretroviral therapy (blue), 2004–2020

Shaded area represents uncertainty intervals.
Fig. 3.3.4 Estimated coverage of antiretroviral therapy for HIV-positive TB cases (HIV-positive TB patients on antiretroviral therapy as a percentage of the estimated incidence of HIV-positive TB) in 2020, 30 high TB/HIV burden countries, WHO regions and globally
Fig. 3.3.5 Treatment outcomes for new and relapse TB cases in 2019, WHO regions and globally

Fig. 3.3.6 Treatment outcomes for new and relapse TB cases, globally, 2012–2019
**Fig. 3.3.7** Treatment outcomes for new and relapse HIV positive TB cases in 2020, WHO regions and globally

**Fig. 3.3.8** Treatment success rate for new and relapse TB cases in children aged 0–14 years in 2019, WHO regions and globally

---

*Data reported by 143 countries on outcomes for 412,418 children aged 0–14 years, equivalent to 79% of the 523,220 cases among children aged 0–14 years that were notified in 2019.
Fig. 3.3.9 Treatment outcomes for new and relapse TB cases (absolute numbers), 2000–2019, globally and for WHO regions

![Graph showing treatment outcomes for new and relapse TB cases](image)

Cohorts before 2013 included new cases only.

<table>
<thead>
<tr>
<th>WHO region</th>
<th>HIV-negative people</th>
<th>HIV-positive people</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Best estimate</td>
<td>Uncertainty interval</td>
<td>Best estimate</td>
</tr>
<tr>
<td>African Region</td>
<td>6.6</td>
<td>5.5-7.7</td>
<td>8.2</td>
</tr>
<tr>
<td>Region of the Americas</td>
<td>1.8</td>
<td>1.7-2.0</td>
<td>0.34</td>
</tr>
<tr>
<td>South-East Asia Region</td>
<td>23</td>
<td>19.28</td>
<td>2.8</td>
</tr>
<tr>
<td>European Region</td>
<td>2.1</td>
<td>1.8-2.3</td>
<td>0.30</td>
</tr>
<tr>
<td>Eastern Mediterranean Region</td>
<td>4.7</td>
<td>4.1-5.3</td>
<td>0.083</td>
</tr>
<tr>
<td>Western Pacific Region</td>
<td>15</td>
<td>14.16</td>
<td>0.48</td>
</tr>
<tr>
<td>Global</td>
<td>54</td>
<td>47.6-80</td>
<td>12</td>
</tr>
</tbody>
</table>
References


3.4 Drug-resistant TB treatment

Treatment for people diagnosed with rifampicin-resistant TB (RR-TB), isoniazid-resistant TB and multidrug-resistant TB (MDR-TB, defined as resistance to isoniazid and rifampicin) requires regimens that include second-line drugs, such as bedaquiline and fluoroquinolones; these regimens are more expensive (≥US$ 1000 per person) and cause more side-effects than first-line treatments for drug-susceptible TB (1). Pre-extensively drug-resistant TB (pre-XDR-TB, defined as TB that is resistant to rifampicin and any fluoroquinolone) and XDR-TB (resistance to rifampicin, any fluoroquinolone and at least one of bedaquiline or linezolid) are even harder to treat.

Globally in 2020, 150 359 people were enrolled on treatment for MDR/RR-TB, down 15% from 177 100 in 2019. Most of those enrolled on treatment were adults (Fig. 3.4.1). There was considerable country variation in treatment enrolment between 2009 and 2020 (Fig. 3.4.2).

The cumulative total number of people reported as enrolled on treatment for MDR/RR-TB from 2018 to 2020 was 482 683, only 32% of the 5-year target (2018-2022) of 1.5 million that was set at the UN high-level meeting on TB in 2018 (Fig. 3.4.3). For children specifically, the cumulative number was 12 219, only 11% of the 5-year target of 115 000.

Substantial improvements in treatment coverage at the global level require an intensification of efforts to diagnose and treat MDR/RR-TB. This requires one or more of the following to be increased:

- the proportion of people with TB who are detected and, of these, the proportion for whom TB is bacteriologically confirmed;
- the proportion of people with bacteriologically confirmed TB who are tested for drug resistance; and
- the proportion of people diagnosed with MDR/RR-TB who are enrolled in treatment.

Globally in 2018 (the latest patient cohort for which data are available), the treatment success rate for people treated for MDR/RR-TB with second-line regimens was 59%; this has improved steadily in recent years, from 50% in 2012 (Fig. 3.4.4). Among WHO regions, the treatment success rate in 2018 ranged from 56% in the European Region to 69% in the African Region (Fig. 3.4.5).

By the end of 2020, 109 countries were using bedaquiline as part of treatment for drug-resistant TB (DR-TB), 90 were using all-oral longer regimens for the treatment of MDR/RR-TB and 65 were using shorter regimens for the treatment of MDR/RR-TB (Fig. 3.4.6, Fig. 3.4.7, Fig. 3.4.8). At least some people diagnosed with DR-TB were being monitored for adverse events in most countries (Fig. 3.4.9).

Country-specific details about treatment for drug-resistant TB are available in the Global tuberculosis report app and country profiles.
Fig. 3.4.1 The global number of people reported to have been enrolled on treatment for MDR/RR-TB, 2015–2020

Global data disaggregated by age are not available for the years before 2018.
Fig. 3.4.2 Number of MDR/RR-TB cases detected [blue] and enrolled on MDR-TB treatment [red], 2010–2020, 30 high MDR-TB burden countries

Fig. 3.4.3 Global progress in the number of people treated for MDR/RR-TB between 2018 and 2020, compared with cumulative targets set for 2018–2022 at the UN high-level meeting on TB

MDR/RR-TB treatment (All ages) 483,000 (32%) treated in 2018–2020

MDR/RR-TB treatment (Children) Target: 115,000 (11%) treated in 2018–2020
**Fig. 3.4.4** Treatment outcomes for MDR/RR-TB cases globally 2012–2018

**Fig. 3.4.5** Treatment outcomes for MDR/RR-TB cases started on treatment in 2018, WHO regions and globally

**Fig. 3.4.6** Countries that used bedaquiline for the treatment of MDR/XDR-TB as part of expanded access, compassionate use or under normal programmatic conditions by the end of 2020
Fig. 3.4.7 Countries that used all-oral longer MDR-TB treatment regimens by the end of 2020

Fig. 3.4.8 Countries that used all-oral shorter MDR-TB treatment regimens by the end of 2020
References

4. TB prevention

Preventing tuberculosis (TB) infection and stopping progression from infection to disease are critical to reduce TB incidence to the levels envisaged by the End TB Strategy. The main health care interventions to achieve this reduction are TB preventive treatment, which the World Health Organization (WHO) recommends for people living with HIV, household contacts of people with TB and other risk groups (1); TB infection prevention and control; and vaccination of children with the bacille Calmette-Guérin (BCG) vaccine. Addressing broader determinants that influence TB epidemics can also help to prevent TB infection and disease; these are discussed in Section 6.3.

At the first United Nations (UN) high-level meeting on TB in 2018, Member States committed to a global target of providing TB preventive treatment to at least 30 million people in the 5-year period 2018–2022: 6 million people living with HIV, 4 million children aged under 5 years who are household contacts of people diagnosed with TB, and 20 million household contacts in older age groups (2). At the UN high-level meeting on HIV and AIDS held in June 2021, countries committed to ensuring that 90% of people living with HIV receive TB preventive treatment by 2025 (3).

The global number of people living with HIV and household contacts of people diagnosed with TB who were provided with TB preventive treatment increased from 1.0 million in 2015 to 3.6 million in 2019, with a particularly large increase (1.4 million) between 2018 and 2019 (Fig. 4.1). However, this positive trend reversed between 2019 and 2020 (Fig. 4.1), probably reflecting disruptions to health services caused by the COVID-19 pandemic. The total number of people provided with TB preventive treatment in 2020 was 2.8 million, a 21% reduction compared with 2019. Progress made in the past 3 years lags far behind that needed to reach the global target set at the UN high-level meeting on TB: the combined total of 8.7 million in 2018–2020 is only 29% of the target of 30 million for the 5-year period 2018–2022 (Fig. 4.2).

Provision of TB preventive treatment to household contacts increased between 2015 and 2019 (Fig. 4.1) but fell from 0.56 million in 2019 to 0.50 million in 2020 (a reduction of 11%). The cumulative number of contacts initiated on TB preventive treatment in the 3-year period 2018–2020, at 1.5 million, is only 6.2% of the target of 24 million for the 5-year period 2018–2022. This number included 1.2 million children aged under 5 years (29% of the 5-year target of 4 million) and 0.32 million people in older age groups (1.6% of the 5-year target of 20 million) (Fig. 4.2).

Globally in 2020, 7.0 million contacts of bacteriologically confirmed pulmonary TB cases were reported, of whom 3.9 million (55%) were evaluated for both TB infection and disease. These numbers were decreases (of 29% and 31%, respectively) from the 9.8 million reported and 5.6 million evaluated in 2019. Coverage of screening and initiation of TB preventive treatment varied widely among countries (Fig. 4.3, Fig. 4.4). There was also considerable variation in treatment completion rates. For the first
time this year, countries reported TB preventive treatment completion data: among household contacts starting TB preventive treatment in 2019, the median completion rate was 86% (IQR, 71–96%) in 80 countries (Fig. 4.5).

Most of those provided with TB preventive treatment to date have been people living with HIV (Fig. 4.1). Globally, the annual number increased from fewer than 30 000 in 2005 to 3.0 million in 2019, before falling to 2.3 million in 2020, a reduction of 23% compared with 2019 (Fig. 4.6). There were reductions in most WHO regions between 2019 and 2020. Six countries - India, Mozambique, Nigeria, South Africa, Uganda and Zambia - each reported initiating over 200 000 people with HIV on TB preventive treatment in 2020, accounting collectively for 74% of the 2.3 million reported globally (Fig. 4.7). Between 2018 and 2020, 7.2 million people with HIV received TB preventive treatment, meaning that the UN high-level meeting target of 6 million has been achieved well ahead of schedule. This represents a milestone achievement. However, accelerated scale-up will be needed to meet the implementation target of 90% by 2025, set out in the End TB Strategy and reaffirmed at the 2021 UN high-level Meeting on HIV and AIDS.

Between 2005 and the end of 2020, 13 million people living with HIV were initiated on TB preventive treatment, equivalent to about one third of the 37.7 million people estimated to be living with HIV in 2020 (4). Coverage varies widely among countries: in eight high TB/HIV burden countries that reported data for 2020, the median coverage was 54% (interquartile range [IQR], 41–79%) among eligible people newly started on antiretroviral treatment. In 20 countries reporting data, a median of 84% (IQR, 70–92%) of people living with HIV who started TB preventive treatment in 2019 completed their treatment. This was the first time that these data were collected.

Reaching the targets for provision of TB preventive treatment set at UN high-level meetings in 2018 and 2021 will require a substantial intensification and expansion of efforts and investment, as highlighted by participants at a WHO high-level event convened in June 2021 (5, 6). This will require more TB screening at household level (especially among people aged 5 years and over), strengthening the follow-up to TB screening at both household level and among people living with HIV, and increased access to shorter (1–3 months) rifamycin-based regimens. The implementation of new WHO recommendations on TB screening released in 2021 (Featured topic on TB guidelines), and the WHO guidelines on TB preventive treatment, including recommendations on rifapentine-containing regimens, will help to achieve these targets. By June 2021, 36 countries reported that they had used shorter rifapentine-containing regimens (including trials and subnational projects), up from 29 one year earlier (Fig. 4.8). Action is now particularly urgent, given the serious disruptions to essential TB services caused by the COVID-19 pandemic since 2020 (Section 1, Section 3).

The risk of TB among health care workers relative to the risk in the general adult population is one of the indicators recommended by WHO for measuring the impact of interventions for TB infection
prevention and control in health care facilities. If effective prevention measures are in place, the risk ratio for TB in health care workers compared with the general adult population should be close to 1. In 2020, 17,511 health care workers from 70 countries were reported to have been diagnosed with TB. The ratio of the TB notification rate among health care workers to the general adult population was greater than 1 in 18 countries that reported five or more TB cases among health care workers (Fig. 4.9).

BCG vaccination is recommended as part of national childhood immunization programmes, in line with a country’s TB epidemiology. The most recent data (7) indicate that 154 countries have a policy of BCG vaccination for the whole population, with 53 of these countries reporting coverage of at least 95% (Fig. 4.10). In a further 32 countries, BCG vaccination is reserved for specific population groups. Of countries reporting BCG coverage data in 2019, 31 reported a reduction in coverage of 5% or more in 2020 compared with 2019; 24 did not report data. This decline was greater than that seen in previous years, and may reflect disruptions to health services caused by the COVID-19 pandemic.

Country-specific details are available in the Global tuberculosis report app and country profiles.
Fig. 4.2 Global progress in provision of TB preventive treatment 2018–2020 compared with cumulative targets set for 2018–2022 at the UN high-level meeting on TB

- **All ages**
  - Target: 30 million 2018–2022
  - 8.7 million treated (29%)

- **People living with HIV**
  - Target: 6 million 2018–2022
  - 7.2 million treated (>100%)

- **Household contacts aged <5 years**
  - Target: 4 million 2018–2022
  - 1.2 million treated (29%)

- **Household contacts aged ≥5 years**
  - Target: 20 million 2018–2022
  - 0.32 million treated (1.6%)

Fig. 4.3 Percentage of household contacts of bacteriologically confirmed pulmonary new and relapse TB cases evaluated for active TB and TB infection, 2020
Fig. 4.4 Coverage of TB preventive treatment among eligible children aged under 5 years, 2020

* Children aged <5 years who were household contacts of bacteriologically confirmed pulmonary TB cases.

Fig. 4.5 Completion of TB preventive treatment among contacts starting treatment, 2019

* Each dot represents a country report.
**Fig. 4.6** Provision of TB preventive treatment to people living with HIV, 2005–2020

![Graph showing the provision of TB preventive treatment to people living with HIV in different regions globally and regionally, including the European Region, African Region, Region of the Americas, and South-East Asia Region.](image)

- Newly enrolled on HIV treatment
- Currently on HIV treatment

*For the period 2005–2010, countries were requested to report data for people newly enrolled in HIV care (dashed lines). Subsequently, countries have been encouraged to report data for people currently on antiretroviral treatment (solid lines).*

**Fig. 4.7** The top six countries providing TB preventive treatment to people enrolled on HIV treatment, 2020

- South Africa
- India
- Zambia
- Uganda
- Mozambique
- Nigeria

![Bar chart showing the percentage of global total for the top six countries providing TB preventive treatment to people enrolled on HIV treatment in 2020.](image)
Fig. 4.8 Use of rifapentine in TB preventive treatment regimens, by June 2021

*Rifapentine is currently registered for use in China, Hong Kong Special Administrative Region, the Democratic Republic of the Congo, Ethiopia, Ghana, India, Indonesia, Mongolia, Myanmar, the Philippines, Singapore, South Africa, Thailand, Turkmenistan, Uganda, and the United States of America (source: Sanofi, June 2021). Several countries in which rifapentine is not yet registered have accessed it using local waiver mechanisms.

Fig. 4.9 Notification rate ratio of TB among health care workers compared with the adult population, 2020
References

5. Financing for TB prevention, diagnostic and treatment services

Progress in reducing the burden of tuberculosis (TB) disease requires adequate funding sustained over many years. The World Health Organization (WHO) began annual monitoring of funding for TB prevention, diagnostic and treatment services in 2002; findings have been published in global TB reports and peer-reviewed publications (1–3). Funding data for 2010–2020 have been reported to WHO by 137 low- and middle-income countries (LMICs), which accounted for 98% of reported TB cases globally in 2020 (Fig. 5.1). Since 2005, funding for TB research has been monitored by the Treatment Action Group, with findings published in an annual report (4).

The Stop TB Partnership’s Global Plan to End TB, 2018–2022 (the Global Plan) estimated that US$ 8.9 billion was required for TB prevention, diagnostic and treatment services in LMICs in 2018, rising to US$ 13.4 billion in 2020 and US$ 15.5 billion in 2022 (5) (Fig. 5.2). It was estimated that an additional US$ 2 billion per year was needed for TB research. At the first United Nations (UN) high-level meeting on TB in 2018, Member States committed to mobilizing at least US$ 13 billion per year for TB prevention, diagnostic and treatment services by 2022, and an additional US$ 2 billion per year for TB research in the 5-year period 2018–2022.

Funding for TB prevention, diagnostic and treatment services continues to fall far short of the globally estimated need and the UN global target (Fig. 5.2, Fig. 5.3, Fig. 5.4). Although funding increased between 2010 and 2014, from US$ 5.2 billion to US$ 6.1 billion, it then declined to US$ 5.3 billion in 2016 and subsequently plateaued at around US$ 5.8 billion per year from 2017 to 2019 (Fig. 5.3, Fig. 5.4). In 2020, global spending on TB services fell for the first time since 2016, to US$ 5.3 billion (an 8.7% fall between 2019 and 2020). This is less than half (39%) of the amount estimated to be required in the Global Plan and less than half (41%) of the global target set at the UN high-level meeting on TB.

The decline in spending between 2019 and 2020 likely reflects several factors. These include an 18% reduction in the global number of people reported as diagnosed with TB between 2019 and 2020 (Section 1, Section 3), 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. Together, these factors mean that spending on outpatient and inpatient care for people diagnosed with TB fell by about US$ 0.4 billion between 2019 and 2020.

As in the past 2 decades, most of the funding available in 2020 (US$ 4.3 billion out of a total of US$ 5.3 billion; i.e. 81%) was from domestic sources (Fig. 5.5). This aggregate figure for 137 LMICs was strongly influenced by the BRICS group of countries (Brazil, Russian Federation, India, China and South Africa), which together accounted for US$ 2.8 billion (65%) of the US$ 4.3 billion domestic funding
available in 2020 (Fig. 5.6). Overall, 95% of the available funding in BRICS and all funding in Brazil, China and the Russian Federation was from domestic sources.

In other LMICs, international donor funding remains crucial (Fig. 5.6). For example, such funding accounted for 53% of the funding available in the 26 high TB burden and two global TB watchlist countries (Cambodia and Zimbabwe) outside BRICS, and 59% of the funding available in low-income countries (LICs) in 2020. In the former group, Bangladesh and Zambia are examples of high TB burden countries that have steadily increased domestic funding specifically allocated for TB (as opposed to funding allocated more generally for inpatient and outpatient care, including for people with TB) since 2015 (by 7-fold) (Fig. 5.7).

The total amount of international donor funding per year averaged US$ 0.9 billion in the period 2010–2020, with some fluctuation (Fig. 5.5). It rose between 2010 and 2013 (from US$ 0.7 billion to US$ 1.0 billion), fell back slightly in 2014 and 2015, peaked in 2017 (at US$ 1.1 billion) and subsequently stabilized at US$ 1.0 billion per year between 2018 and 2020.

The main source of international donor funding is the Global Fund to Fight AIDS, Tuberculosis and Malaria (the Global Fund), with a contribution that ranged from 69% (in 2010) to 83% (in 2017) of the total; in 2020, it was 76% (equivalent to US$ 0.8 billion, 15% of the total of US$ 5.3 billion spent globally). As a share of the total funding reported as required for full implementation of national strategic plans for TB, funding from the Global Fund amounted to 39% of the need in LICs, 33% of the need in lower-middle income countries and 2% of the need in upper middle-income countries. The United States Government is the largest contributor of funding to the Global Fund and also the largest bilateral donor; overall, it contributes close to 50% of international donor funding for TB.

Of the total US$ 5.3 billion available in 2020, US$ 3.2 billion was for diagnosis and treatment of drug-susceptible TB and US$ 2.0 billion was for diagnosis and treatment of multidrug- or rifampicin-resistant TB (MDR/RR-TB) (Fig. 5.3). Both these amounts are less than half (38% and 45%, respectively) of the requirements estimated in the Global Plan (US$ 8.5 billion and US$ 4.4 billion in 2020, respectively) (Fig. 5.2). Since 2010, funding for diagnosis and treatment of drug-susceptible TB has fallen slightly (from a baseline of US$ 4.0 billion) and funding for MDR/RR-TB has more than doubled (from a baseline of US$ 0.9 billion). This growth is largely explained by trends in BRICS (Fig. 5.8), which accounted for 71% of total funding for MDR/RR-TB in the period 2010–2020, and for 54% of the total number of people with MDR/RR-TB who were diagnosed and reported in 2020. The remaining amount (<US$ 0.1 billion) includes funding for TB preventive treatment (covering drugs only) and interventions specifically related to HIV-associated TB.

In 2020, 70 of the 137 LMICs reported that funding was not sufficient for full implementation of their national strategic plans for TB. The total funding gaps reported amounted to US$ 1.6 billion (Fig. 5.9),
with the largest gaps reported by Indonesia (US$ 318 million), Nigeria (US$ 268 million), the Philippines (US$ 152 million) and China (US$ 109 million). Of the 27 LICs, 18 reported funding gaps that amounted to US$ 151 million in 2020.

The funding gaps reported by countries fall far short of the gap between the needs estimated in the Global Plan and the amount of funding available in 2020. For example, in LICs the gap between the needs estimated in the Global Plan and the amount of funding available in 2020 was US$ 1.3 billion (US$ 1.6 billion compared with US$ 0.3 billion). A likely explanation is that the targets included in national plans for TB are much less ambitious than those set out in the Global Plan.

To accelerate progress towards mobilizing the funding needed to reach the UN high-level meeting target of at least US$ 13 billion per year by 2022 (Fig. 5.4) and the requirements set out in the Global Plan (Fig. 5.2), increases in both domestic and international funding for TB are urgently required. The single largest source of funding (76% of the total in 2020) is the Global Fund, so allocations by the Global Fund will be the dominant influence on international donor funding for TB.

Provisional data suggest that allocations for 2021 will remain inadequate. For example, international donor funding reported by national TB programmes (NTPs) is expected to grow by only US$ 147 million between 2020 and 2021. It is possible that this amount may increase through new funding from the Global Fund’s COVID-19 Response Mechanism (C19RM). To date, about US$ 100 million has been allocated for TB through the C19RM. Upcoming applications to the Global Fund (e.g. from the Democratic Republic of the Congo, Indonesia, India, Mozambique, Pakistan and South Africa) may result in additional funding. 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 (Fig. 5.10).

The median cost per person treated for TB in 2020 was US$ 1245 for drug-susceptible TB (Fig. 5.11) and US$ 3868 for MDR/RR-TB (Fig. 5.12). These amounts include all of the provider costs associated with treatment. Estimates of the costs incurred by TB patients and their households during diagnosis and treatment are available from national surveys (Section 6.2).

Further details about funding for TB prevention, diagnostic and treatment services are available in online country profiles and the Global Tuberculosis Report mobile app. Methods for data collection and analysis are described in a technical annex.

The Stop TB Partnership is currently developing a Global Plan to End TB, 2023–2030, which will include updated estimates of resource requirements.
**Fig. 5.1** The 137 low- and middle-income countries included in analyses of TB financing, 2010–2020

**Fig. 5.2** Estimates of funding required for TB prevention, diagnostic and treatment services in 129 low- and middle-income countries, in the Global Plan to End TB 2019–2022

---

8 Funding estimates for collaborative TB/HIV activities exclude the cost of antiretroviral therapy (ART) for TB patients living with HIV. Such costs are included in global estimates of the funding required for HIV, published by UNAIDS.
**Fig. 5.3** Funding for TB prevention, diagnostic and treatment services in total and by category of expenditure, 2010–2020, 137 countries with 98% of reported TB cases in 2020.

Data for TB preventive therapy (drugs only) are only available for 2019 and 2020.

---

**Fig. 5.4** Funding for TB prevention, diagnostic and treatment services for 137 low- and middle-income countries\(^2\) compared with the global target set at the UN high-level meeting on TB of at least US$ 13 billion per year, 2015–2020.

\(^2\) The 137 countries accounted for 98% of the world’s officially reported TB cases in 2020.
**Fig. 5.5** Funding for TB prevention, diagnostic and treatment services by funding source, 2010–2020, 137 countries with 98% of reported TB cases in 2020

**Fig. 5.6** Funding for TB prevention, diagnostic and treatment services from domestic sources and international donors, 2010–2020, 9 country groups

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

* The two global TB watchlist countries included are Cambodia and Zimbabwe.

* Asia includes the WHO regions of South-East Asia and the Western Pacific.

* Other regions consist of three WHO regions: the Eastern Mediterranean Region, the European Region, and the Region of the Americas.
Fig. 5.7 Spending by national TB programmes on TB prevention, diagnostic and treatment services in the 30 high TB burden countries and 3 global TB watchlist countries disaggregated by source of funding, 2010–2020.

* The three global TB watchlist countries are Cambodia, Russian Federation and Zimbabwe (Annex 3 of main report).
**Fig. 5.8** Funding for drug-susceptible TB and MDR/RR-TB, 2010–2020, three country groups

[Graph showing funding trends for BRICS (n=5), High TB burden and global TB watchlist countries outside BRICS* (n=25), and Rest of world (n=164).]

*MDR/RR-TB: multidrug-resistant TB. BRICS: Brazil, Russia, India, China, South Africa.

*The two global TB watchlist countries included are Cambodia and Zimbabwe.

---

**Fig. 5.9** Gaps between the funding required for national strategic plans for TB and available funding as reported by national TB programmes, by income group and by WHO region, 2010–2020

[Graph showing funding gaps for different regions and income groups.]

The total reported gap in 2020 amounted to USD 1.9 billion.

---

92
Fig. 5.10 Sources of funding and funding gaps reported for the TB-specific budgets included in national strategic plans for TB in the 30 high TB burden countries and 3 global TB watchlist countries, 2020\(^a\)

\(^a\) The three global TB watchlist countries are Cambodia, Russian Federation and Zimbabwe (Gates 3 of P2P).
Fig. 5.11 Estimated cost per patient treated for drug-susceptible TB in 122 countries, 2020a

Fig. 5.12 Estimated cost per patient treated for MDR/RR-TB in 104 countries, 2020a
References


6. UHC and TB determinants

6.1 Universal health coverage

The tuberculosis (TB) epidemic is strongly influenced by social and economic development, health-related risk factors (e.g. undernutrition, diabetes, HIV infection, alcohol use disorders and smoking), and geographic and financial access to health care (1–6).

Achieving global targets for reductions in TB disease burden and improved access to TB prevention, diagnosis and treatment services requires progress towards universal health coverage (UHC), combined with action to address health-related risk factors and the broader social and economic determinants and consequences of TB (7).

For example, the World Health Organization (WHO) End TB Strategy target to reduce the number of TB deaths by 75% between 2015 and 2025 is only feasible if, by 2025, everyone who develops TB disease can access high-quality treatment, such that the case fatality ratio (CFR; the percentage of people who develop TB disease that die from it) can be reduced to about 6.5%. This is a level already achieved in high-income countries. In addition, the End TB Strategy target to reduce TB incidence by 80% between 2015 and 2030 is only feasible if, by 2025, the annual decline in TB incidence can be accelerated to 10% per year, a rate of reduction previously documented only in the context of progress towards UHC and socioeconomic development.

All countries have committed to the End TB Strategy targets through their adoption of the End TB Strategy at the World Health Assembly in 2014, and to achieving UHC by 2030 through their adoption of the United Nations (UN) Sustainable Development Goals (SDGs). UHC, social protection and action on TB determinants are part of Pillar 2 of the End TB Strategy and SDG targets and indicators.

The definition of UHC is that everyone can obtain the health services they need without suffering financial hardship (8). Target 3.8 of the SDGs is to achieve UHC by 2030, a commitment that was reaffirmed at a UN high-level meeting in 2019 alongside a new target that an additional 1 billion people have access to quality essential health services by 2023 (9, 10). Two indicators are being used to monitor progress: a service coverage index (SCI) and an indicator of financial protection (Box 6.1.1).
Box 6.1.1

The two SDG indicators for UHC

The first SDG indicator for UHC is the coverage of essential health services (Indicator 3.8.1). This is measured using a service coverage index (SCI). The SCI has values from 0 to 100 and is based on 16 tracer indicators, one of which is TB treatment.

The second indicator is the proportion of the population with large household expenditures on health as a share of total household expenditure or income (Indicator 3.8.2). Two thresholds (10% and 25%) are used to define “large”. When household out-of-pocket expenditures on health surpass these thresholds, the expenditures are classified as “catastrophic” because they may adversely affect a household’s ability to pay for other basic needs.

Both SDG indicators are for the general population. Health expenditures are defined as direct expenditures on medical care, and the denominator 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 through direct expenditures on health care, they may nonetheless have faced financial barriers to accessing health services that they needed.

Indicator 3.8.2 cannot and should not be compared with the End TB Strategy indicator that is defined as the percentage of TB patients and their households facing catastrophic costs due to TB disease (Section 6.2). The TB-specific indicator includes not only direct medical payments for diagnosis and treatment, but also direct non-medical payments (e.g. transportation and lodging) and indirect costs (e.g. lost income). It is also restricted to a specific population: diagnosed TB patients who are users of health services that are part of national TB programme (NTP) networks.

Data for the SCI are currently available for 2000–2017 (Fig. 6.1.1). Globally, the SCI increased steadily in this period, from 45 (out of 100) in 2000 to 66 in 2017. Improvements were made in all WHO regions (especially the Western Pacific Region) and all World Bank income groups. In both 2000 and 2017, low-income and lower-middle-income countries had the lowest SCI values; however, they also had the fastest rate of increase in the SCI. There was little change over time in high-income countries. There is a great deal of variation among countries; in 2017, the highest values were in high-income countries in Asia, Europe and North America, whereas the lowest values were predominantly in countries in the WHO African Region (Fig. 6.1.2).

In contrast to improvements in the SCI, the level of financial protection for expenditures on health has worsened. Globally, the proportion of the general population facing catastrophic expenditures on health (using a threshold of >10% annual household income or expenditure) rose from 9.4% in 2010 to 12.7%
(927 million people) in 2015 (11). National values are available for different years and there is more geographical variability compared with the SCI, including within regions (Fig. 6.1.3).

The distribution of the two UHC indicators in the 30 high TB burden countries and three global TB watchlist countries shows that, in general, values improve with income level, especially for the SCI (Fig. 6.1.4). Nonetheless, the risk of catastrophic health expenditures is high in several middle-income countries, including Bangladesh, Brazil, Cambodia, China, India, Myanmar and Nigeria. Thailand stands out as a high TB burden country with both a high SCI (80) and a high level of financial protection (2% of households facing catastrophic health expenditures). A UHC scheme was established in 2002, supported by domestic funding and a strong primary health care system (12).

To achieve UHC, substantial increases in investment in health are critical. From 2000 to 2017 there was a striking increase in health expenditure (from all sources) per capita in a few high TB burden countries, especially the upper-middle-income countries of Brazil, China, South Africa and Thailand (Fig. 6.1.5). A steady upward trend was evident in India, Indonesia, Liberia, Mongolia, the Philippines and Viet Nam, and there was a noticeable rise from 2012 to 2017 in Myanmar. Elsewhere, however, levels of spending have been relatively stable, and at generally much lower levels.

Although data post-2017 are not yet available, the COVID-19 pandemic is likely to have caused progress towards UHC to stall or reverse in 2020 and 2021 in many countries.

Further country-specific data for the two SDG indicators for UHC are available in the Global tuberculosis report app and online country profiles.
Fig. 6.1.1 Trends in the UHC service coverage index in WHO regions and World Bank income groups, 2000–2017

(a) By region

(b) By income group

Source: WHO Universal Health Coverage data portal (http://apps.who.int/gho/portal/uhc-overview.jsp)
Fig. 6.1.2 UHC service coverage index by country, 2017

Source: WHO Universal Health Coverage data portal (http://apps.who.int/gho/portal/hhc-overview.jsp)

Fig. 6.1.3 Percentage of the general population facing catastrophic health expenditure, a latest available year of data b

a Defined as ≥10% of total household consumption or income.

b The latest available year ranges from 2000 to 2018.

Source: WHO Universal Health Coverage data portal (http://apps.who.int/gho/portal/hhc-overview.jsp)
Fig. 6.1.4 UHC service coverage index (SDG 3.8.1) and percentage of the general population facing catastrophic health expenditures (SDG 3.8.2) for 30 high TB burden countries and three global TB watchlist countries, stratified by income group.

(a) Data are for 2017.
(b) Defined as ≥10% of total household consumption or income. The latest available year ranges from 2007 to 2018 for the 30 high TB burden countries.
(c) The three global TB watchlist countries are Cambodia, Russian Federation and Zimbabwe.
(d) As per the 2021 World Bank classification.

Fig. 6.1.5 Current health expenditure per capita, 30 high TB burden countries, 2000–2018

(a) Low-income countries

(b) Upper-middle-income countries

(c) Lower-middle-income countries

Sources: WHO Global Health Expenditure Database [http://apps.who.int/nha/databases/HealthExpenditure]
References


6.2 National surveys of costs faced by TB patients and their households

The World Health Organization (WHO) End TB Strategy includes the target that no tuberculosis (TB) patients or their households face catastrophic costs (including direct medical expenditures, non-medical expenditures and income losses) because of TB disease. Monitoring of progress towards this target can inform monitoring of progress towards universal health coverage (UHC); however, this target should not be confused or directly compared with the Sustainable Development Goal (SDG) UHC indicator for financial protection from health care expenditures among the general population (Box 6.1.1). WHO has established standard methods for conducting a national survey to assess the direct and indirect costs incurred by people with TB and their households (TB patient cost surveys) (1).


In the 23 surveys for which results have been reported, the percentage of TB patients and their households that experienced catastrophic total costs (defined as >20% of household expenditure or income) ranged from 13% (95% confidence interval [CI]: 10–17%) in El Salvador to 92% (95% CI: 86–97%) in Solomon Islands (Fig 6.2.2). The pooled average for all 23 countries, weighted for each country’s number of notified cases, was 47% (95% CI: 33–61%) (Fig. 6.2.3).

Among 19 countries that reported disaggregated data, the pooled averages were 45% (95% CI: 35–56%) for drug-susceptible TB and 87% (95% CI: 80–93%) for drug-resistant TB (DR-TB) (Fig. 6.2.3). The percentage of TB patients with DR-TB and their households that experienced catastrophic total costs ranged from 50% (95% CI: 14–86%) in Burkina Faso to 100% (95% CI: 92–100%) in Uganda.

The distribution of costs varied among countries (Fig. 6.2.4) but it was evident that – despite the widespread norm of “free TB care” policies – TB-affected households still face direct medical costs. Such costs accounted for a sizeable proportion of total costs in some countries (e.g. 19% in both Ghana and Mongolia). Minimizing direct medical costs borne by TB patients should be a high priority for national TB programmes (NTPs) and ministries of health.
The surveys also showed that actions are needed to eliminate non-medical costs and to reduce income losses. The combined cost of transportation, food, nutritional supplements and other non-medical expenditures ("direct non-medical costs") accounted for a substantial share of total costs in some countries, including Solomon Islands (80%), Fiji (73%), Kenya (64%), Uganda (60%), El Salvador (58%), Timor-Leste (53%), and the United Republic of Tanzania (51%).

Income losses associated with loss of employment or time lost while seeking or staying in care accounted for the largest single share of total costs in Burkina Faso (77%), Brazil (65%), Papua New Guinea (59%), Mongolia (57%), Lesotho (50%), Myanmar (48%), Nigeria (47%) and Viet Nam (44%).

All cost categories are influenced by the model of TB care; for example, to what extent there is reliance on hospitalization or outpatient care, the frequency with which attendance at health facilities is requested and the level to which services are decentralized to bring the services close to the community. They are also influenced by ease of access to the health facilities used to provide care.

Further details of individual national surveys are available elsewhere (2–8). In addition, WHO, in collaboration with national survey teams, is currently preparing a publication that will provide full details about the results and policy implications of the national TB patient cost surveys completed in 2016–2020. This book is due to be published in early 2022.
**Fig. 6.2.2** Estimates of the percentage of TB patients and their households facing catastrophic costs, national surveys implemented 2016-2020

- All TB
  - Solomon Islands
  - Timor-Leste
  - Zimbabwe
  - Nigeria
  - Morocco
  - Georgia
  - Lao People's Democratic Republic
  - Viet Nam
  - Myanmar
  - Democratic Republic of the Congo
  - Burkina Faso
  - Uganda
  - Brazil
  - United Republic of Tanzania
  - Philippines
  - Fiji
  - Indonesia
  - Benin
  - Papua New Guinea
  - Thailand
  - Kenya
  - Lesotho
  - El Salvador
  - Pooled average

- Drug-resistant TB only
  - Zimbabwe
  - Nigeria
  - Mongolia
  - Ghana
  - Lao People's Democratic Republic
  - Viet Nam
  - Myanmar
  - Democratic Republic of the Congo
  - Burkina Faso
  - Uganda
  - Brazil
  - United Republic of Tanzania
  - Philippines
  - Indonesia
  - Benin
  - Papua New Guinea
  - Thailand
  - Kenya
  - Lesotho
  - Pooled average

---

8 Estimates for all TB patients were based on 23 country surveys that have been completed and the data were reported. Among them, disaggregated estimates were available only for 19 countries.

Source: WHO Global TB Programme

---

**Fig. 6.2.3** Average percentage of people with TB and their households facing catastrophic costs in 24 national surveys completed since 2015

- **All people with TB**
  - 47%
  - 95% CI: 33-61%

- **People with drug-susceptible TB**
  - 45%
  - 95% CI: 35-56%

- **People with drug-resistant TB**
  - 87%
  - 95% CI: 80-93%
References

6.3 TB determinants

The tuberculosis (TB) epidemic is strongly influenced by social and economic development and health-related risk factors such as undernutrition, diabetes, HIV infection, alcohol use disorders and smoking. Achieving global targets for reductions in TB disease burden requires progress on these fronts, as highlighted in Section 6.1. For example, numbers of TB cases and deaths started to decline in western Europe, North America and some other parts of the world around the turn of the 20th century, as incomes grew, levels of poverty fell, and housing and nutrition improved (1, 2). The fastest declines in TB incidence and TB mortality in western Europe occurred in the 1950s and 1960s, in the context of progress towards universal health coverage (UHC), rapid social and economic development, and the availability of effective drug treatments.

The World Health Organization (WHO) has developed a framework for monitoring the Sustainable Development Goals (SDGs) related to TB. The framework comprises 14 indicators for which a relationship with TB incidence could be established, under seven SDGs (Table A6.1). Five are health-related risk factors for TB and six are broader socioeconomic determinants; the other 3 indicators, for UHC and current health expenditures, are covered in Section 6.1. There is a particularly clear relationship between TB incidence and undernutrition and gross domestic product (GDP) per capita (Fig. 6.3.1).

Globally in 2020, an estimated 1.9 million incident cases of TB were attributable to undernutrition, 0.74 million to HIV infection, 0.74 million to alcohol use disorders, 0.73 million to smoking and 0.37 million to diabetes (Table A6.1). However, there is considerable variation among countries in the relative contribution of the five factors (Table 6.3.2, Fig. 6.3.2), and thus also variation in which of these factors need to be prioritized as part of national efforts to reduce the burden of TB disease.

The most recent data for undernutrition and five socioeconomic indicators associated with TB incidence are shown for the 30 high TB burden and three global TB watchlist countries in Fig. 6.3.3. In this figure, the outer edge of the hexagon (100) is the ideal value for each indicator. Therefore, better performance corresponds to a larger shaded region. To represent this situation visually, the indicators “proportion of the urban population living in slums” and “proportion of the population living below the international poverty line” are inverted in the figure. All indicator values in the figure are for the general population as opposed to people with TB; values for TB patients specifically (e.g. out-of-pocket expenditure and access to social protection) may differ from these general values.

Based on the latest available data in the World Bank database, some upper-middle-income and lower-middle-income countries (e.g. Brazil, China, India, Indonesia, South Africa and Thailand) appear to be performing relatively well. However, progress is likely to have been set back by the COVID-19 pandemic. Even before the pandemic, other high TB burden countries already faced major challenges.
in achieving a range of TB-related SDG targets. Moreover, values for poor populations and vulnerable groups most at risk of developing TB are likely to be worse than national averages.

Addressing broader determinants of the TB epidemic requires multisectoral action and 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 (3). 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 (4).

Further country-specific details for the 14 indicators related to TB incidence are available in the Global tuberculosis report app and online country profiles.

**Fig. 6.3.1** The relationship between GDP per capita and the prevalence of undernutrition, and TB incidence per 100 000 population

**TABLE 6.3.1** Global estimates of the number of TB cases attributable to selected risk factors, 2020

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Relative risk (uncertainty interval)</th>
<th>Exposed (millions)</th>
<th>Population attributable fraction (%)</th>
<th>Attributable TB cases (millions, uncertainty interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol use disorders</td>
<td>3.3 (2.1–5.2)</td>
<td>291 000</td>
<td>8.1</td>
<td>0.74 (0.31–1.3)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.5 (1.3–1.8)</td>
<td>496 000</td>
<td>3.1</td>
<td>0.37 (0.15–0.68)</td>
</tr>
<tr>
<td>HIV infection</td>
<td>18 (15–21)</td>
<td>37 500</td>
<td>7.6</td>
<td>0.74 (0.65–0.83)</td>
</tr>
<tr>
<td>Smoking</td>
<td>1.6 (1.2–2.1)</td>
<td>1 050 000</td>
<td>7.1</td>
<td>0.73 (0.25–1.5)</td>
</tr>
<tr>
<td>Undernourishment</td>
<td>3.2 (3.1–3.3)</td>
<td>637 000</td>
<td>19</td>
<td>1.9 (1.3–2.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Prevalence of undernourishment (% of population aged 16–49 years)</th>
<th>HIV prevalence (% of population aged ≥15 years)</th>
<th>Smoking prevalence (% of population aged ≥15 years)</th>
<th>Diabetes prevalence (% of population aged ≥15 years)</th>
<th>Alcohol use disorders, 12 month prevalence (% of population aged ≥15 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Angola</td>
<td>19</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td></td>
<td></td>
<td>10</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>2.5</td>
<td>0.90</td>
<td>9.5</td>
<td>17</td>
<td>8.7</td>
</tr>
<tr>
<td>Cambodia</td>
<td>14</td>
<td>0.50</td>
<td>2.0</td>
<td>32</td>
<td>6.9</td>
</tr>
<tr>
<td>Central African Republic</td>
<td></td>
<td></td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>2.5</td>
<td></td>
<td>1.8</td>
<td>48</td>
<td>7.6</td>
</tr>
<tr>
<td>Congo</td>
<td>28</td>
<td></td>
<td>3.1</td>
<td>70</td>
<td>25</td>
</tr>
<tr>
<td>Democratic People’s Republic of Korea</td>
<td>48</td>
<td></td>
<td>0</td>
<td>38</td>
<td>5.9</td>
</tr>
<tr>
<td>Democratic Republic of the Congo</td>
<td></td>
<td></td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethiopia</td>
<td>20</td>
<td></td>
<td>0.90</td>
<td>70</td>
<td>6.1</td>
</tr>
<tr>
<td>Gabon</td>
<td>17</td>
<td></td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>14</td>
<td></td>
<td>0</td>
<td>22</td>
<td>8.3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>9.0</td>
<td></td>
<td>1.9</td>
<td>60</td>
<td>8.0</td>
</tr>
<tr>
<td>Kenya</td>
<td>23</td>
<td></td>
<td>4.5</td>
<td>20</td>
<td>6.2</td>
</tr>
<tr>
<td>Lesotho</td>
<td>33</td>
<td></td>
<td>2.30</td>
<td>60</td>
<td>9.9</td>
</tr>
<tr>
<td>Liberia</td>
<td>38</td>
<td></td>
<td>1.5</td>
<td>10</td>
<td>7.6</td>
</tr>
<tr>
<td>Mongolia</td>
<td>21</td>
<td></td>
<td>5.1</td>
<td>45</td>
<td>11</td>
</tr>
<tr>
<td>Mozambique</td>
<td>33</td>
<td></td>
<td>12</td>
<td>44</td>
<td>27</td>
</tr>
<tr>
<td>Myanmar</td>
<td>14</td>
<td></td>
<td>0.70</td>
<td>4.4</td>
<td>36</td>
</tr>
<tr>
<td>Namibia</td>
<td>15</td>
<td></td>
<td>12</td>
<td>8.1</td>
<td>34</td>
</tr>
<tr>
<td>Niger</td>
<td>13</td>
<td></td>
<td>1.3</td>
<td>0.30</td>
<td>7.9</td>
</tr>
<tr>
<td>Pakistan</td>
<td>12</td>
<td></td>
<td>0.10</td>
<td>3.0</td>
<td>38</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td></td>
<td></td>
<td>0.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>14</td>
<td></td>
<td>0.20</td>
<td>7.0</td>
<td>42</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>2.5</td>
<td></td>
<td>0</td>
<td>16</td>
<td>41</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>26</td>
<td></td>
<td>1.6</td>
<td>8.5</td>
<td>31</td>
</tr>
<tr>
<td>South Africa</td>
<td>5.7</td>
<td></td>
<td>19</td>
<td>7.1</td>
<td>34</td>
</tr>
<tr>
<td>Thailand</td>
<td>9.3</td>
<td></td>
<td>1.0</td>
<td>1.7</td>
<td>39</td>
</tr>
<tr>
<td>Uganda</td>
<td></td>
<td></td>
<td>5.8</td>
<td>2.6</td>
<td>13</td>
</tr>
<tr>
<td>United Republic of Tanzania</td>
<td>25</td>
<td></td>
<td>4.3</td>
<td>2.0</td>
<td>20</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>6.4</td>
<td></td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zambia</td>
<td></td>
<td></td>
<td>12</td>
<td>3.0</td>
<td>24</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td></td>
<td></td>
<td>13</td>
<td>1.3</td>
<td>26</td>
</tr>
</tbody>
</table>

— Data were not available.

Sources: World Bank Sustainable Development Goals Database (http://data.worldbank.org/indicator) and WHO Global Health Observatory (https://www.who.int/gho)
Fig. 6.3.2 Estimated number of TB cases attributable to five risk factors, 30 high TB burden countries and three global TB watchlist countries, 2020

Best estimates (in colour) and uncertainty intervals (black) are shown.


Blank areas (missing bars) represent no data available.
Fig. 6.3.3 Status of selected SDG indicators beyond SDG 3 in high TB burden countries, latest available year

Income equality: An Inverse GINI index is shown where 0 is perfect equality and 100 is perfect inequality.
Not in poverty: Percentage of population living above the international poverty line.
Social protection: Percentage of population covered by social protection and labour programmes.
Not in slums: Percentage of urban population not living in slums.
Clean fuels: Percentage of population with access to clean fuels and technologies for cooking.
Nutrition: Percentage of population not undernourished.

References


7. TB research and innovation

Tuberculosis (TB) research and innovation is essential to achieve the global TB targets of the United Nations (UN) Sustainable Development Goals (SDGs) and the World Health Organization (WHO) End TB Strategy. The SDG target is to “end the epidemic” by 2030; more specific targets for 2030 set in the End TB Strategy are a 90% reduction in TB deaths and an 80% reduction in TB incidence compared with 2015 levels, with targets for further reductions (95% and 90%, respectively) by 2035. Reaching these targets requires major technological breakthroughs by 2025, such as a TB vaccine that is effective both before and after exposure, so that the rate at which TB incidence falls can be dramatically accelerated compared with historic levels (2% per year globally in recent years, with the fastest national declines of around 10% per year achieved in the 1950s and 1960s), to an average of 17% per year between 2025 and 2035.

“Intensified research and innovation” is the third pillar of the End TB Strategy. This includes research and development of affordable and accessible rapid point-of-care tests for TB infection and TB disease; shorter, safer and more effective treatments for TB infection, drug-susceptible TB and drug-resistant TB (DR-TB); a TB vaccine that is effective before and after exposure; and innovative strategies to address broader determinants of TB, such as poverty, undernutrition, HIV infection, smoking and diabetes. Target 3b of the SDGs includes supporting research and development related to vaccines and medicines for “communicable and non-communicable diseases that primarily affect developing countries”.

The political declaration at the first UN high-level meeting on TB, held in 2018, included the first global funding target for TB research to be agreed by all UN Member States. The target is to mobilize US$ 2 billion per year in the period 2018–2022. Although funding has been slowly increasing (Fig. 7.1), the latest published data show that only US$ 901 million was available in 2019 (1). This was a decrease from US$ 906 million in 2018 and was less than half of the global target.

WHO continues to promote and monitor progress in the development of new TB vaccines, diagnostics and medicines.

The diagnostic pipeline remains robust in terms of the number of tests, products or methods in development (Table 7.1). These include newer skin tests for TB infection based on recombinant early secretory antigen target (ESAT)-6 and culture filtrate protein (CFP)-10 antigens, with better performance than tuberculin skin tests, particularly in terms of specificity; next-generation lateral-flow lipoarabinomannan (LF-LAM) assays that perform better than currently marketed assays, particularly in terms of sensitivity; amplification-based targeted next-generation sequencing (NGS) assays for detecting DR-TB directly from sputum specimens; broth microdilution methods for drug-susceptibility testing (DST); an expanding pipeline of new interferon gamma release assays (IGRAs) to test for TB
infection; and several computer-aided detection (CAD) software products employing artificial intelligence to screen for TB on digital chest radiographs. A growing number of nucleic-acid amplification test (NAAT) products are available; these products are automated, are of low to moderate complexity, and can detect both TB and resistance to various anti-TB drugs (e.g. rifampicin, isoniazid and fluoroquinolones). Six new technologies for the molecular detection of TB and resistance to anti-TB drugs were endorsed by WHO in 2021. These are: FluoroType MTB and MTBDR, Hain Lifescience, Germany; Abbott RealTime MTB and MTB RIF/INH on m2000sp and m2000rt systems, Abbott, United States of America (USA); BD Max MDR-TB, Becton Dickinson, USA; Roche cobas® MTB and MTB-RIF/INH on Cobas 6800/880 systems, Roche Diagnostics, Switzerland; Genoscholar PZA TB II, Nipro, Japan; and Xpert MTB/XDR cartridge, Cepheid, USA.

In August 2021, there were 25 drugs for the treatment of drug-susceptible TB, multidrug-resistant TB (MDR-TB) or TB infection in Phase I, Phase II or Phase III trials (Table 7.2, Table 7.3). These drugs comprise 16 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.

There are 14 vaccine candidates in clinical trials: two in Phase I, eight in Phase II and four in Phase III (Table 7.4). They include candidates to prevent TB infection and TB disease, and candidates to help improve the outcomes of treatment for TB disease.

Further details about the products in clinical trials can be found by clicking on the links in Table 7.2, Table 7.3, and Table 7.4.

A Global Strategy for TB Research and Innovation was adopted by the World Health Assembly in August 2020 (2). It provides strategic guidance for how to accelerate research and innovation efforts that are aligned to the needs of Member States. The strategy calls for an enabling environment for research; mobilization of increased domestic and international investments in TB research; leveraging of the potential of data sharing; and global collective action to improve equitable access to the benefits of research and innovation. In 2021, WHO launched a situational assessment checklist (3) to help countries to contextualize the implementation of the global strategy through changes in policies, programmes and interventions. To promote research driven by country needs that is aligned to the recommendations of the global strategy, WHO is providing support to the secretariat of a TB research network that comprises Brazil, Russian Federation, India, China and South Africa (BRICS) (4). In 2020, WHO’s Global TB Programme co-hosted and facilitated three meetings of this BRICS TB research network, covering a range of TB research projects.
Considering that many of the inequalities that facilitate TB transmission and disease have been exacerbated by the COVID-19 pandemic, WHO has established a compendium of resources on TB and COVID-19 to facilitate evidence-based adaptation of TB services (5). The compendium includes a list of research projects; an inventory of peer-reviewed or preprint manuscripts; and a compilation of case studies on programmatic innovations that address emerging challenges in TB prevention and care (see featured topic on TB/COVID-19 case studies).

WHO will complete a health and economic impact assessment of the full value of new TB vaccines in 2021. The assessment is intended to guide investments in late-stage research as well as the introduction and implementation of new TB vaccines (6). WHO is also developing a research agenda on TB social protection, to build the high-quality evidence required to guide efforts to address the social and economic determinants and consequences of TB.

In 2021, WHO convened a multistakeholder consultation to discuss the emerging needs of Member States for policy guidance, evidence gaps for policy-making, translation of research evidence into policy and strategies to enhance the implementation of global TB policy guidance (7).

---

**Fig. 7.1** Funding for TB research, 2015–2019

![Graph showing funding for TB research, 2015–2019](https://www.treatmentactiongroup.org/resources/brd-report/brd-report-2020/)

<table>
<thead>
<tr>
<th>Table 7.1</th>
<th>An overview of progress in the development of TB diagnostics, August 2021</th>
</tr>
</thead>
</table>

### Technologies endorsed by WHO

#### Molecular detection of TB and/or drug resistance
- Xpert MTB/RIF and Xpert MTB/RIF Ultra, Cepheid, USA
- GenoType® MTBDRplus, Hain Lifescience/Bruker, Germany
- Genoscholar™ NTM+MDR TB II, Nipro, Japan
- GenoType® MTBDRsl, Hain Lifescience/Bruker, Germany
- TB LAMP, Eiken, Japan
- Truenat MTB, MTB Plus and MTB-RIIF Dx assays, Molbio Diagnostics, India
- FluoroType MTB and MTBDR, Hain Lifescience, Germany
- Abbott RealTime MTB and MTB Rif/INH on m2000sp and m2000rt systems, Abbott, USA
- BD Max MDR-TB, Becton Dickinson, USA
- Roche cobas® MTB and MTB-RIIF/INH on Cobas 5800/880 systems, Roche Diagnostics, Switzerland
- Genoscholar PZA TB II, Nipro, Japan
- Xpert MTBEDR cartridge, Cepheid, USA

#### Culture-based technologies
- Commercial liquid culture, DST systems and rapid speciation
- Microscopy
  - Light and light-emitting diode microscopy (diagnosis and treatment monitoring)
- Biomarker based assays
  - Determine TB-LAM Ag, Abbott, USA
  - Interferon gamma release assays (IGRAs) for TB infection
    - T-Spot.TB, Oxford Immunotec, UK
    - QuantIFERON-TB Gold Plus (QFT-Plus), Qiagen, USA
- Computer-aided detection (CAD) for digital chest radiography
  - CADTB v6, Delft Imaging, Netherlands
  - Lunit INSIGHT CXR (TB algorithm v4.0), Lunit, Republic of Korea
  - qXR v2,quire.ai, India

### Technologies under evaluation by WHO

#### Culture-based drug susceptibility testing
- Sensititre MTB MYCOTBI plate, ThermoFisher Scientific Inc., USA

#### Culture-free, targeted-sequencing solutions for detection of TB drug resistance
- DeepChem® DST, ABL, France
- Deepplex®-McTB, Genoscreen, France
- NanoTB, Oxford Nanopore Technologies, UK

#### Biomarker based assays
- Fujifilm SILVAMP TB LAM Assay, Fujifilm, Japan

### On the market (Not yet evaluated by WHO)

#### Molecular detection of TB and/or drug resistance
- AccuPower TB & MDR Real Time PCR Kit, Bioneer, Republic of Korea
- AccuPower XDR-TB Real Time PCR Kit-A, Bioneer, Republic of Korea
- AccuPower XDR-TB Real Time PCR Kit-B, Bioneer, Republic of Korea
- EasyNAT TB Diagnostic kit, Ustar Biotechnologies, China
- Genachip, TB drug resistance array, Capital Bio, China
- iCubate System, iCubate, USA
- fioDr mmMDR-TB, EMPE Diagnostics, Sweden
- MDR/MTB ELIté MSB® Kit / ELIté InGenius® platform, ELITech Group, Italy
- Ustar Biotechnologies (Hangzhou), China

#### Interferon gamma release assays (IGRAs) for TB infection
- Advansure TB IGRA, LG chem, Republic of Korea
- Atlas NOVA assay, China
- Lieferon TB/LTB, LIONEX Diagnostics & Therapeutics GmbH, Germany
- QuantIFERON.TB Direct, USA
- VIDAS TB-IGRA, bioMérieux, France

#### Computer-aided detection (CAD) for digital chest radiography
- AXIR, RadiSen, South Korea
- Genki, Deepleak, USA
- InterRead DR Chest, InterVISION, China
- JF CXR-1, IF HEALTHCARE, China
- XrayAME, Epon, Belgium
Technologies in development

**Molecular detection of TB and drug resistance**

- FluoroType XDR-TB assay, Hain Lifescience, Germany
- GenoType MTB/RIF ID, Epsiten, UK
- INFINITI MTB Assay, AutoGenomics, USA
- IRON qPCR Q-RTA (proXDR-TB RT PCR), Bioneer, Republic of Korea
- MetPro TB assay, Zeesan Biotech, China
- Mycobacterium Tuberculosis Rapid NAT Test Kit, Bao Ruyuan Biotech (Beijing) Co. Ltd, China
- STANDARD M DRR-TB; MDR-TB; XDR-TB; SD biosensor, Republic of Korea
- QuantuMDx, PO: L, UK
- TruArray MDR-TB, Alkomi, USA
- Truenat MTB-INHMTB-FQ/MTB-BDO, Molbio, India

**Biomarker based assays**

- BioMesereus ISIT-TB on BioFire FilmArray, France
- RiSK6 host response assay, QuantuMDx, UK
- Salus FLOW TB Lumea LAM Assay, Salus Discovery LLC, USA
- T cell activation marker (TAM-TB) assay, Ludwig-Maximilians-University, Munich, Germany
- TB LAM assay, Molipic, UK
- TB LAM assay, SD biosensor, Republic of Korea
- TB Molecular Bacterial Load Assay, University of St Andrews, U.K.
- TB Triage multiplex LFA, LUMC, The Netherlands & the TB Triage consortium
- Xpert MTB Host response assay, Cepheid, USA

**Interferon gamma release assays (IGRAs) for TB infection**

- ichrom™ IGRA-TB, Boditech Med Inc., Republic of Korea
- IP-10 IGRA-elsa/elisa lateral flow, rBioPharm, Germany
- T-Track(R) TB, Lophius Biosciences GmbH, Germany

**Computer-aided detection (CAD) for digital chest radiography**

- ChestEye & ChestLink Oxipit, Lithuania
- DrCADx, Dr CADx, Zimbabwe
- T-Xsiet, Artelus, India
Table 7.2  The global clinical development pipeline for new anti-TB drugs and drug regimens to treat TB disease, August 2021

<table>
<thead>
<tr>
<th>Phase I&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Phase II&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Phase III&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macozinone&lt;sup&gt;b&lt;/sup&gt;</td>
<td>BTZ-043&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Bedaquiline (TMC-207)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>BVL-GSK098&lt;sup&gt;b&lt;/sup&gt;</td>
<td>GSK-3036656&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Delamanid (OPC-67603)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>GSK-286 (GSK 2556286)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Macozinone&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Pretomanid&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>TBAJ-587&lt;sup&gt;b&lt;/sup&gt;</td>
<td>OPC-167832&lt;sup&gt;b&lt;/sup&gt;</td>
<td>High-dose rifampicin for treatment of drug-susceptible TB (BEAT TB trial)</td>
</tr>
<tr>
<td>TBAJ-876&lt;sup&gt;b&lt;/sup&gt;</td>
<td>SPR720&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Bedaquiline–delamanid–linezolid–levofloxacin–clofazimine (6-month oral regimen for RR-TB) or bedaquiline–delamanid–linezolid–clofazimine (6-0 month oral regimen for pre-XDR and XDR-TB) (SimpliciTB trial)</td>
</tr>
<tr>
<td>TBI-166&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Telacebec-(Q203)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Bedaquiline–pretomanid–moxifloxacin–pyrazinamide (BPrelAZ) (SimpliciTB trial)</td>
</tr>
<tr>
<td>TBI-223&lt;sup&gt;b&lt;/sup&gt;</td>
<td>TBA-737&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Bedaquiline–pretomanid–linezolid (ZeNix trial) - Linezolid optimization</td>
</tr>
<tr>
<td>ACTG A5312</td>
<td>Delpazolid&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Bedaquiline with two OBRs&lt;sup&gt;c&lt;/sup&gt; (all-oral, 9 months; with injectable, 6 months) (STREAM trial)</td>
</tr>
<tr>
<td></td>
<td>SQ109&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Bedaquiline–linezolid–levofloxacin with OBR&lt;sup&gt;c&lt;/sup&gt; for MDR-TB (NEXT trial)</td>
</tr>
<tr>
<td></td>
<td>Sutezolid&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Bedaquiline and delamanid with various existing regimens for MDR-TB and XDR-TB (endTB trial)</td>
</tr>
<tr>
<td></td>
<td>High-dose rifampicin for drug-susceptible TB (PanACEA)</td>
<td>Bedaquiline–delamanid–linezolid–clofazimine for fluoroquinolone-resistant MDR-TB (endTB-Q)</td>
</tr>
<tr>
<td></td>
<td>Bedaquiline and delamanid (ACTG 5343 DELIBERATE trial)</td>
<td>Several 2-month regimens for drug-susceptible TB (TRUNCATE-TB trial)</td>
</tr>
<tr>
<td></td>
<td>Bedaquiline and pretomanid with existing and re-purposed anti-TB drugs for MDR-TB (TB PRACTECAL Phase III trial)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A5962 Shorter regimens including clofazimine and rifapentine for drug-susceptible TB (CLO-FAST trial)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretomanid-containing regimens to shorten treatment for drug-susceptible TB (APT trial)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Delamanid–linezolid–levofloxacin–pyrazinamide for fluoroquinolone- susceptible MDR-TB (MDR-END trial)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Levofloxacin with OBR&lt;sup&gt;c&lt;/sup&gt; for MDR-TB (Opti-Q)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4-month treatment for drug-susceptible TB (PredicTB trial)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High-dose rifampicin for TB meningitis (ReDEFINe)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiple adjunctive host-directed TB therapies for drug-susceptible TB (TBHD)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from the Working Group on New TB Drugs pipeline. More information on these products and other ongoing projects can be found at https://www.newtbdrugs.org/pipeline/clinic.

<sup>a</sup> New drug compounds are listed first, followed by repurposed drugs and then by regimens.
<sup>b</sup> New chemical entity.
<sup>c</sup> Optimized Background Regimen.
### Table 7.3 The global clinical development pipeline for new drugs and drug regimens to treat TB infection, August 2021

<table>
<thead>
<tr>
<th>Phase III</th>
<th>Phase III/IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOLPHIN and DOLPHIN TOO</td>
<td>A5300B/2003/PHCENRx</td>
</tr>
<tr>
<td>IMPAACT P2001</td>
<td>TB-CHAMP</td>
</tr>
<tr>
<td>TBTC Study 35</td>
<td>TBTC Study 37/ASTERoid, Phase II/I</td>
</tr>
<tr>
<td>Higher dose rifampin for 2 months vs standard dose rifampin-2R2</td>
<td>SDR: 1HP vs 3HP</td>
</tr>
<tr>
<td>Impact of 3HP on pharmacokinetics of tenofovir alafenamide-YODA</td>
<td>V-QUIN trial</td>
</tr>
<tr>
<td>Impact of 3HP on pharmacokinetics of dotulitavir and darunavir, with cobicistat</td>
<td>WHIP3TB</td>
</tr>
<tr>
<td>Drug-drug interactions between rifapentine and dotulitavir in HIV/LTB co-infected individuals</td>
<td>1HP vs 3HP among people living with HIV</td>
</tr>
<tr>
<td></td>
<td>1HP vs 3HP among people uninfected with HIV</td>
</tr>
</tbody>
</table>

### Table 7.4 The global clinical development pipeline for new TB vaccines, August 2021

<table>
<thead>
<tr>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
</tr>
</thead>
<tbody>
<tr>
<td>AttLivAg88SA McMaster, Canada</td>
<td>CBtN01x95A-MVA88SA (IFM/Avanos) University of Oxford</td>
<td>BCG ReVac (Gates MIRI)</td>
</tr>
<tr>
<td>AECC/BC02 Asthul Zimel Longcom</td>
<td>ID93 + GLA-SE IDR: Welcome Trust, IAVI</td>
<td>DAR-991 booster Dartmouth, GHT</td>
</tr>
<tr>
<td></td>
<td>TB/FLU-A4L RIIASP</td>
<td>H68, C31 (SSSI, Geneva, IAVI)</td>
</tr>
<tr>
<td></td>
<td>MT2/A501E GSK, Bakers MIRI</td>
<td>MTB Vac (Diflaxin, TBI, University of Zaragoza)</td>
</tr>
<tr>
<td></td>
<td>RUTI (a) Archivel Farms, S.L.</td>
<td>VRM-002 (StPL, VPM)</td>
</tr>
</tbody>
</table>

*a Information was self-reported by vaccine sponsors to WHO or to the Stop TB Partnership Working Group on New TB Vaccines.

*b Vial Vector

*c Mammalian - Live

*d Protein / Adjunct

**Mycobacterial – Whole Cell or Extract

References


4. BRICS TB Research Network. See (http://bricstb.samrc.ac.za)


120
Tuberculosis (TB) surveillance is the continuous and systematic collection, analysis and reporting of data related to TB infection and TB disease in the population. To support countries to implement national surveillance systems for TB in a consistent and comparable way worldwide, the World Health Organization (WHO) has, since the mid-1990s, provided guidance with standardized definitions, forms, registers and reports (1). There were major updates to this guidance in 2006 (2) and 2013 (3).

A new edition of guidance on TB surveillance is in development and will be published in 2022. It will have an expanded scope that covers the full pathway of screening, diagnosis, treatment and care for people with TB infection and TB disease. It also aims to facilitate implementation of digital, case-based, real-time surveillance systems for TB, including the strengthening of systems that already exist and the transition to such systems elsewhere, especially in countries that are using a mixture of paper-based and digital systems or that rely primarily on paper-based systems.

Digital and case-based real-time surveillance systems for TB have several advantages over more traditional paper-based reporting of aggregated data. These include enabling the use of automated data quality checks, timely access to data and the availability of individual-level data for people with TB infection or disease, from the level of health facilities up to national level. These systems also greatly facilitate data analysis (including by age, sex and location) to inform adaptation and targeting of response efforts, both geographically and for specific population groups.

As of August 2021, data on the type of TB surveillance system in place at national level were available for 210 countries and territories (Fig. 1). Of these, 130 reported having in place a digital, case-based surveillance system that covered all people diagnosed and reported with TB (both those with drug-susceptible TB and those with drug-resistant TB [DR-TB]). A further 14 countries, mainly in the WHO regions of Africa, the Americas and South-East Asia, had a case-based surveillance system only for people with DR-TB. Twenty countries reported that they were in the process of transitioning from a paper to digital system. About half of the countries in the WHO African Region still have paper-based systems for the recording and reporting of data.

The WHO Global TB Programme has been working with other WHO departments, the University of Oslo and the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) to develop and support country implementation of digital packages for the collection, analysis, visualization and use of data from routine health facility information systems (4). This has built on WHO guidance about case-based
digital TB surveillance (5), guidance on the routine analysis and use of TB data (6) and the WHO TB surveillance checklist of standards and benchmarks (7). The packages are based on WHO data standards and have been developed using DHIS2 software (because many countries have already chosen DHIS2 for use within their health information systems) but can be adapted for use with other software. Each package contains a machine-readable DHIS2 configuration, an analysis guide with a core set of indicators and dashboards, and an accompanying exercise book.

A TB-specific package for the digital management, analysis and use of key surveillance data in aggregated format has been available since early 2019 (8), for use by countries that are not yet ready to transition to case-based digital surveillance. The TB package for case-based data, which enables the digital management of data for both drug-susceptible TB and DR-TB in a single system, has been available since late 2020 for download as a digital data configuration package in both English and French (8). Both TB packages are based on the latest WHO recording and reporting framework, and both allow extensive data analysis at different levels of the health system (e.g. health facility and subnational administrative area). The standard dashboards include graphs, tables and maps for core surveillance indicators (e.g. notifications, coverage of testing for drug resistance and HIV, and treatment outcomes) and data quality indicators (e.g. completeness and internal consistency).

The status of implementation and use of the WHO digital package for aggregated TB data is shown in Fig. 2. Historical subnational TB data from 60 countries have been stored and can be analysed and visualized in this package. At national level, the digital package for aggregated data has already been implemented for ongoing collection, analysis, visualization (using standard dashboards) and reporting of data in 18 countries; an additional 12 countries are in the process of doing the same. In a further 22 countries, the package has been used to upload historical data for analysis during a national TB epidemiological review. As of August 2021, piloting of the TB digital package for case-based data was underway in four countries.

The longer term goal is that all countries are able to rely on a unified case-based digital environment for TB surveillance, along the complete pathway of prevention and care for people at risk of TB infection and TB disease; an illustration is shown in Fig. 3. This will be supported by WHO standards for metadata, indicators and analytics (via a software-agnostic digital accelerator kit for TB, for countries that would like to develop the environment in the software of their choice), as well as a fully developed environment in DHIS2 (for countries that are looking for an off-the-shelf solution).

The success of case-based digital surveillance for TB in most countries is not just about the availability of technical products (e.g. digital packages, data standards and guidance). Other prerequisites include the necessary infrastructure, a competent core national health information and surveillance team, 

---

1 WHO cross-cutting and disease-specific digital data configuration packages in DHIS2 can be downloaded from the website.
sufficient staffing and funding, and political commitment to TB data. WHO is currently developing standardized terms of reference for national assessments of readiness to adopt and implement case-based digital TB surveillance, in collaboration with stakeholders including national and local governments, technical agencies, funding agencies and civil society.

**Fig. 1 Countries with national, case-based digital surveillance systems for TB, 2020**

![Map of countries with national, case-based digital surveillance systems for TB, 2020](image)

**Fig. 2 Global status of implementation and use of the WHO TB DHIS2 packages for health facility and case-based data, 2017–2020**

![Map of global status of implementation and use of the WHO TB DHIS2 packages](image)

MDR-TB: multidrug-resistant tuberculosis.

Fig. 3 An illustration of a unified, digital environment for TB surveillance, along the pathway of care

References

Country success stories in implementing innovative TB responses to the COVID-19 pandemic

The COVID-19 pandemic has adversely affected essential tuberculosis (TB) services in many countries. This is most evident in the sharp fall in the global number of people with TB who were diagnosed and reported to national authorities between 2019 and 2020 (-19%, from 7.1 million to 5.8 million), with even larger reductions in several high TB burden countries (Section 1, Section 3.1). There have also been reversals in the provision of TB preventive treatment (Section 4), spending on TB services and coverage of bacille Calmette-Guérin (BCG) vaccination (Section 5) (1).

Countries have implemented a variety of approaches to mitigate the impact of the pandemic on essential TB services. Major examples documented by the World Health Organization (WHO) in the Global tuberculosis report 2020, based on data reported by 184 countries, included reductions in the required frequency of outpatient visits for treatment monitoring or collection of drugs, allowing TB patients to take home a 1-month or more supply of anti-TB drugs, allowing TB patients to nominate another household member to collect anti-TB drugs on their behalf, and expanded use of remote advice and support (2).

To support countries to effectively respond to disruptions to essential TB services due to COVID-19, in late 2020, WHO launched a call for case studies of innovative responses that had succeeded in mitigating or reversing negative impacts. The aim was to compile, document and disseminate examples of best practices, and associated new knowledge and lessons learned. A first report comprising 23 case studies from all six WHO regions was issued in May 2021 (3).

More than half of the 23 case studies described the successful implementation of digital interventions, including for telemedicine, video-supported treatment, TB surveillance and programmatic monitoring (Table 1). This is consistent with data previously reported to WHO in 2020 (2) and from other surveys (4). The report also provides examples of how public-private sector alliances and enhanced community engagement are being forged or strengthened. The case studies also show how TB-related actions have contributed to COVID-19 management (e.g. the use of rapid molecular diagnostic platforms for diagnosis of both diseases, use of existing decentralized service provision structures and patient education platforms for TB to support the COVID-19 response, and drawing on TB-related experience in how to address vulnerabilities). Summaries of a selection of the 23 case studies are provided in (Box 1).
The case studies show that, in the face of a crisis, countries have expanded the use of newer tests and treatments as well as digital technologies, some of which have been recommended for a long time. The TB community at all levels needs to sustain and build on this progress.

Publication of the case studies by WHO in May 2021 was done in time for the studies to inform applications to the COVID-19 Response Mechanism (C19-RM) of the Global Fund to Fight AIDS, Tuberculosis and Malaria, which was created to mitigate the pandemic’s impact on HIV, TB and malaria. The website of the WHO Global TB Programme also includes a compendium of resources on TB and COVID-19 (5), including research projects and an inventory of peer-reviewed or preprint manuscripts. WHO plans to publish an updated report, with additional country case studies, before the end of 2021.

Box 1

Highlights of selected country case studies from the 2021 WHO report on innovative TB responses to disruptions caused by the COVID-19 pandemic

Brazil
Following increasing strain on the local health care system in Manaus, Brazil, there were disruptions to TB patient support, including adherence support. The Municipal Secretary of Health of Manaus established a telemonitoring platform using baseline data from local and national databases and electronic patient records to screen and prioritize TB patients who could benefit from telemonitoring. At the time of submission of the case study to WHO, 96% of targeted patients had responded to at least 50% of the programmed calls, allowing health care workers to provide treatment support.

Ethiopia
A project on childhood TB in the Kaffa and Bench-Sheko areas of Ethiopia experienced a dramatic decrease in patient flow because of the COVID-19 pandemic. Following a needs assessment, a package of mitigation measures was implemented. This included making health facilities safer for patients and providers, providing training and guidance, facilitating specimen transport through use of digital applications, and providing support for integrated screening for COVID-19 and TB. Within 3-4 months of initiating the mitigation measures, use of TB services reverted to close to pre-COVID-19 levels.

India
In the Samastipur district of Bihar, India, TB diagnostic services in the public health system were severely impacted when TB laboratory personnel were assigned to the COVID-19 response. Innovators in Health (India) purchased an additional GeneXpert machine and hired laboratory staff, while the district supplied cartridges to boost active case-finding. The role of community health workers employed by the government was also extended from treatment supervision to the entire pathway of TB care, to improve early case detection, diagnosis and care. These interventions increased the Xpert MTB/RIF
testing capacity of the TB programme by 67% and improved testing for two comorbidities (HIV and diabetes) in private laboratories, allowing the project to meet its projected targets despite the pandemic.

**Myanmar**

In Myanmar, patient support for people with drug-resistant TB (DR-TB) was adversely impacted by the COVID-19 pandemic. The Union adapted its socioeconomic support for people with DR-TB through a digital cash-transfer payment (Wave Money) and provided telecounselling at the time of testing. More than 95% of TB patients with DR-TB received monetary support. These interventions reduced loss to follow-up, hardship and suffering for people with TB and for their contacts.

**Pakistan**

Districts supported by Mercy Corps in Pakistan saw a 39% reduction in TB case notifications because of public health measures implemented in response to the COVID-19 pandemic, coupled with stigma, COVID-19 infections among health care workers and fewer community referrals. Mercy Corps implemented public-private interventions to improve TB diagnostic and treatment services through targeted projects in clinics, large private hospitals and “outreach chest camps” for vulnerable populations; self-referrals through interactive voice calls; engagement of female health care workers; transport of sputum specimens by community riders; and awareness-building forums. These measures allowed for continuity of services, with 98% of TB patients able to continue their treatment without interruption in supported districts.
References


The COVID-19 pandemic and TB in India: impact and response

A. Impact on TB disease burden

Estimates of tuberculosis (TB) disease burden in India for 2000–2019 were published in the World Health Organization (WHO) Global tuberculosis report 2020 (1). The estimates were based on results from a statewide TB prevalence survey in 2011–2012, time trends in the prevalence of TB infection (measured in surveys), and cause-of-death data from verbal autopsy studies and a sample vital registration system. Given the disruptions to TB diagnosis and treatment caused by the coronavirus disease (COVID-19) pandemic (Section 1), production of estimates of TB disease burden for 2020 specifically required new methods based on dynamic models of TB transmission. The model used for India was informed by near real-time case notification data reported online in Nikshay, the national TB reporting system (2), which showed a 25% annual shortfall in case notifications in 2020 compared with 2019 (Section 1).

The transmission model is illustrated schematically in Fig. 1 below (details and governing equations are described in the technical annex to the main report). The model captures the COVID-19 response’s indirect effects on TB, focusing on reduced access to care and some level of diagnostic and human resources being diverted to COVID-19 services; overall, these factors have led to delays in diagnosis and initiation of treatment.

As shown in Fig. 1, the effect of routine TB services is to remove individuals with active, infectious TB at a rate \( d \), and to initiate them on TB treatment. The adverse effect of disruptions related to the COVID-19 response is to modify this rate by a time-dependent factor, \( k(t) \). Nikshay data for notifications were used to inform the monthly time series for \( k(t) \). Other rates shown in Fig. 1 are as follows: \( \lambda \), time-dependent force of infection; \( w \), per-capita transition rate from “latent, fast” to “latent, slow”; \( u \), per-capita hazard of breakdown to active disease in the first 2 years after infection; \( v \), per-capita rate of reactivation thereafter; \( \mu_{TB} \), per-capita hazard of TB mortality; \( r \), per-capita rate of treatment completion; and \( \rho \), per-capita rate of relapse. The values and data sources used for model parameters are shown in Annex 1 below.

The model structure for India accounted for the private and public sectors separately. Other model features that are not shown (for simplicity) in Fig. 1 are reinfection, spontaneous cure and the potential for higher post-treatment relapse following treatment non-completion.

A key assumption was that any reduction in TB case notifications, compared with an extrapolation of pre-2020 trends, was due to delays in diagnosis and treatment initiation rather than shortfalls in
reporting. Moreover, it was assumed that the proportion of people with TB who were diagnosed but not reported remained the same in 2020 as in 2019. Delays in diagnosis associated with the COVID-19 pandemic may have arisen from factors related to individuals (e.g., people with symptomatic TB being less willing or able to seek care during periods of COVID-19 restrictions) or to health systems (e.g., services having less TB diagnostic or staff capacity than in normal times). The model structure is agnostic to either of these factors; instead, the whole journey of health care seeking is captured in the rate $d$. This was a deliberate choice in the modelling (usually, additional compartments would be included to reflect the time to seek medical care separately from the time to investigate and diagnose TB).

To capture the implications of reduced notifications for diagnostic delays, the model includes a month-by-month adjustment to the baseline detection rate in 2019, denoted as $k(t)$ in Fig. 1. Monthly values for this adjustment were matched to the monthly time series of Nikshay notification data (Fig. 2). These data provide information separately for the public sector and for private providers reporting to the national TB elimination programme (NTEP). In this way, the model accounts for disruptions in the public and private sectors separately. It was assumed that private sector disruptions evident in Nikshay data could be extrapolated to the private sector in India more broadly.

With its focus on delays in diagnosis and treatment initiation, the model ignores other possible disruptions, including those to treatment continuity among people already on TB treatment. However, previous analysis suggests that such disruptions are likely to have a weaker effect on TB incidence than disruptions to diagnosis and treatment initiation (3).

The model does not include direct effects of the COVID-19 pandemic, such as a possible increased risk of mortality in people with both COVID-19 and TB. Preliminary results from the ongoing national TB disease prevalence survey were also not used. For projections post-2020, TB detection and treatment services were assumed to have fully recovered by June 2021.

An important source of uncertainty is the extent to which TB transmission was reduced during periods of national lockdown. Wide uncertainty intervals were adopted, with the strength of reduction assumed to be uniformly distributed between 25% and 75%.

In view of these limitations and others described in Annex 5 of the main report (PDF), the resulting estimates for 2020 and projections up to 2025 should be considered provisional.

Fig. 3 shows resulting model projections of incidence and mortality. The impact of disruptions related to COVID-19 on case detection is relatively small and delayed, whereas the impact on TB mortality is much bigger and more rapid. The relative decline in TB incidence estimate rates from 2019 to 2020 is 2.8% (2.9% in 2018–2019), indicating only a small slowing down of the pre-COVID-19 decline. In
contrast, the TB mortality rate is estimated to have increased by 11% from 2019 to 2020 (compared with a 2.6% decline from 2018 to 2019).

More empirical data on the impact of the COVID-19 pandemic on TB in India are needed to support further model refinement and development. Results from the national TB prevalence survey are expected to inform future estimates. It is possible that continued use of masks and physical distancing may have contributed to continued reductions in TB transmission, even after the lifting of formal restrictions. Any emerging evidence to this effect would be incorporated in future estimates.

### B. Response by the National TB Elimination Programme

India’s NTEP took various actions to mitigate the effects of the COVID-19 pandemic on TB services. As a result, the overall impact on TB diagnostic and treatment services was less than the impact on outpatient and inpatient services in general. The number of case notifications of people newly diagnosed with TB fell by 25% in 2020 compared with 2019, while the reduction in the total number of attendances at inpatient and outpatient services was 38%. The main actions taken by the NTEP are highlighted below.

#### Diagnostic services

Bi-directional screening was introduced to ensure screening for COVID-19 among people diagnosed with TB and screening for TB among people diagnosed with COVID-19. The number of machines for nucleic-acid amplification tests (NAATs) was doubled through the procurement of 159 GeneXpert (CBNAAT) machines and 1512 Truenat machines, which increased diagnostic capacity by an additional 9200 COVID-19 tests and 4600 TB tests per day (4). This helped to ensure that TB diagnostic capacity that had initially been diverted for COVID-19 testing was restored and enhanced; sputum smear microscopy testing for TB was replaced with NAATs for all those with presumptive TB. Laboratory services for TB and COVID-19 testing were also decentralized and integrated to optimize their use. Referral linkages between TB and COVID-19 services were established.

#### Case finding

Intensified case finding for both TB and COVID-19 were prioritized in all outpatient departments of the public sector, and home-based sample collection services were provided during periods of lockdown. An active TB case-finding campaign was initiated in areas in which relatively few cases of COVID-19 were being detected. Health centres initiated community-based screening for TB using a standardized checklist during house-to-house surveys for population enumeration, and contact tracing was strengthened for the household and workplace contacts of people diagnosed with bacteriologically
confirmed TB. In addition, migrant camps were mapped as the basis for systematic case finding and patient follow-up and support in these settings.

Considerable efforts were also made to ensure continued engagement with the private sector. A national government directive was issued to state and local administrations after the first lockdown, with the aim of reopening private clinics, hospitals and laboratories. State administrations worked with professional bodies and associations such as the Indian Medical Association, Pediatrics Association of India, Indian Chest Society, and Federation of Obstetric and Gynecological Societies of India to ensure the provision of TB care. Actions included the provision of information about the mandatory nature of case notification and the availability of free anti-TB drugs and diagnostics from the NTEP.

Outreach activities were conducted as part of initiatives such as “Joint efforts for elimination of TB”, and by agencies and nongovernmental organizations providing patient and provider support. A toll-free number was established to provide information to both health professionals and the general public.

**Treatment services**

People on TB treatment were provided with at least monthly supplies of anti-TB drugs and were given the option of home delivery. Adequate stocks of drugs were ensured, including through the involvement of private chemists and the use of decentralized “drug refill” facilities in urban areas. Digital technologies were used to enable reporting and monitoring of adverse drug reactions without the need to attend a health facility. Airborne infection control measures were implemented in all public health facilities, including in patient registration and waiting areas. Hand-washing facilities and “corners” were also established at government health facilities, alongside information on the mandatory use of masks, physical distancing and cough etiquette.

**Patient support**

Each district identified a person to handle calls from people with presumptive TB or those already diagnosed with TB, to assist them with services such as sample collection, drug delivery and linkages with a treatment supporter or nearby health care worker. “TB cards” were provided to facilitate assistance for people being investigated or treated for TB. Efforts were made to reduce patient visits to health care facilities and, where possible, services were offered in a single location. A citizen and patient centric application, “TB Aarogya Sathi”, was launched to offer a connection between TB patients and health providers from a distance.
Provider support

Guidelines for standard precautionary measures for health care workers in all health facilities were issued and were accompanied by widespread provision of online training to health staff in the public and private sectors. Plans to progressively relieve NTEP staff from duties related to COVID-19 were implemented.

Direct-benefit transfers

Any pending direct-benefit transfers for people with TB were cleared within 1 month, and the turnaround time for payments was reduced from more than 100 days to less than 30 days. People diagnosed with TB whose bank details were not available were contacted for submission of bank account details in Nikshay, to ensure prompt payments of benefits.

Demand generation

Intensive local communication campaigns about TB and COVID-19 were undertaken. These were aimed at addressing stigma related to COVID-19, improving health care seeking behaviour, and sustaining measures such as social distancing, personal hygiene and mask wearing. Targeted activities were undertaken for key populations including migrants, urban slum dwellers, people living with HIV, miners and farmers.

Rational use of personal protective equipment

General guidance for the rational use and disposal of personal protective equipment (PPE) was issued by India’s Ministry of Health (5).

Monitoring and evaluation

The transition from paper-based recording and reporting of TB data to Nikshay was completed, including laboratory services and commodity procurement. A quarterly national report on the TB situation was provided to all states. Assessment of the burden of TB disease at subnational levels was undertaken and used as the basis for issuing certificates to recognize “achievements for efforts to end TB”. Operational and implementation research was commissioned on priority research topics.
Fig. 1 A schematic illustration of the structure of the TB transmission model used for India

Fig. 2 Model calibration: matching detection rates to case notifications

Fig. 3 Model projections of incidence (left) and mortality (right)

References

Annex 1: Model parameters and values

Table A1: Model parameter values and data sources used to estimate the TB disease burden in India in 2020 and to produce projections for 2021–2025.

<table>
<thead>
<tr>
<th>Calibration targets</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB incidence per 100,000 population, 2019</td>
<td>165 (132, 255)</td>
<td>(1)</td>
</tr>
<tr>
<td>TB mortality per 100,000 population, 2019</td>
<td>32 (30, 34)</td>
<td>(1)</td>
</tr>
<tr>
<td>Notifications per 100,000 population, 2019, public</td>
<td>127</td>
<td>(2)</td>
</tr>
<tr>
<td>Notifications per 100,000 population, 2019, private</td>
<td>50</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Natural history parameters

- LTBI among "fast" progressors, annual hazard rate of breakdown to active disease: 0.083 (0.062, 0.10) | (3) |
- LTBI among "slow" progressors, annual hazard rate of reactivation to active disease: 8×10⁻⁴ (4×10⁻⁴, 7.9×10⁻⁴) | (3) |
- Number of infections per untreated TB case per year: 12.2 (9.2–16) | Calibrated to data for incidence |
- Annual mortality hazard in the absence of treatment: 0.97 (0.50, 0.84) | (4), parameters determined so that untreated TB case has an average duration of 3 years with CFR of 50% |
- Per-capita rate of self-cure in the absence of treatment: 0.97 (0.50, 0.84) | (4), parameters determined so that untreated TB case has an average duration of 3 years with CFR of 50% |

TB care parameters

- Average delay before initiation of TB treatment (pre-COVID-19, including patient delay): 7.9 mo (5.1–15) | Calibrated to data for incidence and notifications |
- Proportion of TB patients being managed by the public (vs. private) sector: 0.61% (63–78%) | Calibrated to match data for notifications by public sector |
- Completion rates for first-line TB treatment, public: 94% | (2) |
- Completion rates for first-line TB treatment, private (engaged): 76% | (2) |

Post-TB parameters

- Protection from reinfection from past TB: 90% (60–99%) | (5) |
- Post-cure hazard of relapse, following successful treatment completion: 0.002 (0.002–0.04) | (6) |
- Post-cure hazard of relapse, following self-cure or treatment interruption: 0.14 (0.1–0.2) | (7), assuming same hazard of relapse for self-cure as for those interrupting treatment |

References (Table A1)

The WHO multisectoral accountability framework for TB (MAF-TB): progress in adaptation and implementation

Tuberculosis (TB) remains one of the top infectious killers in the world, and further innovations and multisectoral actions are needed to reach the World Health Organization (WHO) End TB Strategy targets. Despite universal acknowledgement that TB is driven by social and economic determinants, the TB response is still mainly focused on the health sector (1). Multisectoral engagement is critical, given the impact of COVID-19 on health systems and economies worldwide, especially on the poorest people.

The political declaration of the 2018 United Nations (UN) General Assembly high-level meeting on TB (2) includes a commitment by Member States to enable and pursue multisectoral engagement and accountability at global, regional, national and local levels to end TB. The declaration also includes a request to the Director-General of WHO to ensure timely implementation of a multisectoral accountability framework for TB. The WHO Global TB Programme (GTB) subsequently released the Multisectoral accountability framework to accelerate progress to end tuberculosis by 2030 (MAF-TB) in May 2019 (3). The aim of MAF-TB is to support effective collaboration and accountability of governments and stakeholders at all levels to ramp up the response towards ending TB. The framework will help to facilitate multisectoral action, mutual accountability and measurement of progress towards commitments on TB at global, regional, national and subnational levels.

The UN Secretary-General’s 2020 report on progress towards achieving global TB targets and implementation of the UN political declaration on TB (4) also highlights the importance of multisectoral engagement for progress towards ending TB. The report includes a request for WHO to continue supporting Member States to adapt and use the MAF-TB in collaboration with partners, civil society and affected communities, and lead periodic global reviews of the TB response.

Status of MAF-TB adaptation and implementation

WHO provides coordination, guidance and technical support to countries and stakeholders for adapting and implementing MAF-TB, and for monitoring and review at global, regional and country levels.

All three levels of WHO are working closely with various organizations to build capacity, increase awareness and share best practices and experiences of multisectoral engagement and accountability. The collaborating organizations include UN agencies – for example, the International Labour Organization (ILO), International Organization for Migration, UN High Commissioner for Refugees,
World Food Programme (WFP) and UN Children’s Fund (UNICEF) – and other partners such as the WHO Civil Society Task Force (CSTF) and civil society and community organizations.

A special WHO portal on MAF-TB, with key resources and opportunities for questions and answers, has been promoted on WHO’s interactive End TB Forum platform, which features several hundred members. The portal helps to share knowledge, relevant information and best practices on MAF-TB implementation and use, and helps to engage different stakeholders and sectors. It is used also for the organization of WHO End TB webinars with a spotlight on MAF-TB, which also engage other UN agencies. Furthermore, WHO co-hosted a conference and is working closely with the Health and Social Protection Action Research and Knowledge Sharing (SPARKS) network to improve social protection approaches in the context of the COVID-19 pandemic (5).

Based on the WHO global data collected in 2021 (Table 1) there has been notable progress in MAF implementation. A total 157 countries, including almost all (29) high TB burden countries, published annual TB reports on progress toward national TB-related targets and commitments. National mechanisms for high-level review of progress towards ending TB have been established in 125 countries, 19 of which are high TB burden countries. Civil society and affected communities are actively engaged in the multisectoral accountability and review processes in 87 countries, 15 of which are high TB burden countries.

WHO regional offices are working closely with WHO country offices, civil society representatives and partners to provide technical support to the countries in implementation of MAF-TB. In 2020–2021, with the support from the WHO Regional Office for Europe, five pilot countries (Belarus, Moldova, Kazakhstan, Tajikistan and Ukraine) initiated operationalization and adaptation of the MAF-TB to their national context. Box 1 presents four country case studies and Box 2 highlights examples of national multisectoral actions for the social protection of people with TB supported by UN agencies.

Findings from the MAF-TB baseline assessment, 2021

To facilitate the implementation of MAF-TB at country level, WHO developed the MAF-TB checklist (6) and supported baseline assessments. Results from the assessments inform further steps to adapt and implement MAF-TB at national level.

Global TB Programme analysis and evaluation of the MAF-TB baseline assessment in 45 responding countries indicates progress in implementation of the four essential MAF-TB components (commitments, actions, monitoring and reporting, and review). All four components are in place in 17 of the 45 countries included in the MAF-TB baseline assessment (Fig. 1).

Thirty countries reported on the translation into national policies of targets from the Sustainable Development Goals (SDGs), the WHO End TB Strategy or the UN high-level meeting political
declaration on TB. Ongoing were normalization of key commitments on strengthening multisectoral accountability mechanisms; pursuing science, research and innovation; and fund mobilization for universal access to TB diagnosis, treatment and care. Ten countries showed examples of concrete actions in place.

Fifteen countries have formalized their national multisectoral coordination mechanisms, while 25 countries have updated their national strategic plans aligned with MAF-TB principles on integration of TB services within primary health care and addressing HIV as a TB risk factor. However, fewer than half of the responding countries have in place the integration of multisectoral actions to address other risk factors and social determinants of TB (e.g. undernutrition and poverty).

Among the 45 countries that participated in the MAF-TB baseline assessment, 40 have a strong TB surveillance system (routine recording and reporting on TB via national information system) in place and are reporting annually to WHO via the global TB data collection system. The latest national assessments of TB surveillance in 29 of the 30 high TB burden countries confirm and complement the findings from the MAF-TB baseline assessments. In particular, 27 countries have surveillance systems that meet WHO requirements for standardization and consistency in the case definitions used and type of data collected. The periodic transmission of data and quarterly reports upstream from subnational levels to national level requires continued attention because only 10 countries have such a system in place. Similarly, fewer than half of the high TB burden countries have either partially or fully transitioned from paper to digital case-based surveillance systems, and 23 countries did not meet the standards related to diagnosis and reporting of data on TB in children. National vital registration (VR) systems with high coverage and coding of causes of death according to international standards is challenging and requires strengthening.

Research and study data to inform planning are increasingly available. Among the countries in the MAF-TB baseline assessment, 24 have national evidence-based data available from surveys and studies such as prevalence, patient cost and drug resistance surveys, and inventory and other special studies.

A total of 36 of the 45 reported countries do not have high-level leadership engagement for the periodic review of the TB response. In about half of the countries included in the baseline assessment, there is no clearly defined list of accountable stakeholders beyond the health sector. Furthermore, relevant indicators for the performance measurement of accountable stakeholders are not set and no budget is assigned for TB-specific activities. In fewer than half of the countries, the TB response is still covered only by the health sector and is the responsibility of the ministry of health (MoH).

Civil society and affected communities, most notably in high TB burden countries, are engaged in all four components of MAF-TB, especially in setting and implementation of commitments. This is consistent with the WHO global data collected in 2021 (Table 1). Engagement in activities related to
monitoring and reporting is limited, however – only nine responding countries had set performance indicators to measure civil society engagement in TB response.

In general, countries are progressing in their adaptation and roll-out of the latest WHO guidelines on TB diagnosis and treatment, released between 2016 and 2020, with more than 80% of countries that participated in the MAF-TB baseline assessment making progress. In particular, WHO guidelines on the treatment of drug-resistant TB (7) are implemented in half of the reported countries. According to the WHO global TB data, 90 countries are using all-oral longer TB treatment regimens and 65 are using shorter treatment regimens for multidrug-resistant or rifampicin-resistant TB (MDR/RR-TB).

WHO will continue to provide technical support for country adaptation and implementation of MAF-TB, and will be publishing operational guidance and best practices on MAF-TB implementation.

Box 1

Highlights from country case studies on MAF-TB adaptation and implementation

Belarus

In Belarus, the National Tuberculosis Programme (NTP), in collaboration with the secretariat of the Country Coordinating Mechanism of the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) and with the support of the MoH, initiated a baseline assessment using the MAF-TB checklist. The baseline assessment recommended the establishment of a working group to develop a mechanism for the timely revision, adaptation and alignment of national protocols and strategic documents to the WHO guidelines, roadmaps and frameworks, and their timely implementation at national level. This recommendation is being implemented with support from the WHO Regional Office for Europe and the WHO Country Office for Belarus. Lessons learned from this experience will also help other countries in the region in their efforts to operationalize WHO guidelines.

Ukraine

In Ukraine, the results of the MAF-TB baseline assessment were presented and endorsed in the meeting of the National Council on Tuberculosis and HIV/AIDS in June 2021. One of the assessment recommendations was the development of a national roadmap for 2021–2023, for strengthening multisectoral collaboration and accountability mechanisms. This process will be coordinated jointly by the Secretariat of the National Council, MoH, NTP and a national group on advocacy, communication and social mobilization. A hearing of the Parliamentary Health Committee supported development of
the national roadmap and requested the President Administration to organize an annual high-level review to track progress towards national targets and commitments to end TB.

To facilitate a joint vision on multisectoral coordination and accountability in the response to TB, national multistakeholder dialogue with TB-affected communities at the heart of the process and participation of relevant governmental ministries and bodies, and stakeholders beyond the health sector, is planned for November 2021.

**Kenya**

In Kenya, the process of MAF-TB adaptation and implementation is led by a national secretariat that includes representation from the NTP, WHO and the Stop TB Partnership-Kenya, with engagement of TB survivors (under their national network of champions) and other implementing partners.

In 2020, Kenya established a MAF-TB technical and coordinating committee. This developed a concise concept note with a roadmap, conducted a baseline assessment and mapped out relevant sectors and stakeholders. Several sectors were engaged (e.g. the ministries of Health, Education, Sports, Transport, Judiciary, Finance, Home Affairs and Foreign Affairs) in an analysis of strengths, weaknesses, opportunities and threats (SWOT), as the basis for definition of approaches and actions to be taken by stakeholders to ensure a multisectoral TB response. Subsequently, the development of a national MAF-TB document was initiated, with technical and financial support from the WHO Country Office in Kenya and the African Regional Office (AFRO), and in collaboration with partners and various sectors. This will culminate in a comprehensive framework that is scheduled for finalization and endorsement by the end of 2021.

**Russian Federation**

In the Russian Federation, a set of multisectoral measures at a high political level (including a high-level coordination mechanism) has achieved significant success in TB burden reduction. The country reached the 2020 milestones of the End TB Strategy for reduction of TB incidence and TB mortality and, for the first time in 22 years, left the list of high TB burden countries. The NTP of the Russian Federation has targets and commitments that align with the WHO End TB Strategy, and there is engagement of different sectors beyond the MoH (e.g. the penitentiary sector, labour, social protection, science, education, and industry and trade). The programme includes objectives for each of the sectors, with performance indicators set and the budget assigned. Monitoring, review and reporting is provided on a quarterly and annual basis. The overall supervision and coordination is provided by the government and prime minister, with regular reporting to the president.
Box 2

Multisectoral action to implement social protection for people affected by TB: examples of strategies supported by UN agencies

Multisectoral action and accountability to address the broader social and economic determinants and consequences of TB and achieve the End TB Strategy targets is taking place in several countries, with support from UN agencies and in close collaboration with national governments and partners.

In Madagascar, the WFP is working with the NTP to provide nutrition support and counselling to malnourished TB patients. In 2020, WFP supported the development of a national integrated TB and HIV social and behaviour change communication strategy, including nutrition-related behaviour change interventions.

In Djibouti, to mitigate the socioeconomic impact of the COVID-19 pandemic, WFP is complementing the national social protection programme (Programme National de Solidarité Famille, PNSF) with a cash transfer programme for the most vulnerable households affected by HIV and TB. In addition, WFP strongly advocates that national counterparts include these households into the PNSF. WFP, with the support of two local nongovernmental organizations (Le Réseau and Solidarité Féminine), and in close collaboration with the MoH and Ministry of Social Affairs and Solidarity (MASS), leads the implementation of this programme, which delivers cash to HIV and TB affected households for 9 months. To reduce barriers related to stigma and discrimination, beneficiaries are also enrolled in the national social registry managed by MASS, in the same way as other PNSF beneficiaries. Once enrolled in PNSF, beneficiaries are automatically eligible for health insurance under the Programme d'Assistance Sociale de Santé (PASS).

In India, the ILO is supporting implementation of the World of Work Programme. This programme aims to strengthen the integrated policy framework for TB and HIV/AIDS at the workplace, to secure employment and assure that workers with TB and HIV can continue medical treatment without discrimination in the workplace. It is implemented in collaboration with the Ministry of Health and Family Welfare, Ministry of Labor and Employment, civil society organizations, enterprises in the public and private sector, employers’ and workers’ organizations, and various development partners, such as the United States Agency for International Development (USAID), Joint United Nations Programme on HIV and AIDS (UNAIDS) and WHO. As a result of this multisectoral collaboration, a national integrated policy framework on addressing TB and HIV in the world of work was developed. Furthermore, in 2019, a “Statement of Commitment of Indian Employers’ organizations on addressing TB and HIV in the world of work” was jointly issued by public and private enterprises.
Fig. 1 MAF-TB essential components in place globally and in high TB burden countries (%)

Table 1 Status of core elements of multisectoral accountability in 2021 for 30 high TB burden countries, WHO regions and globally

<table>
<thead>
<tr>
<th>High TB burden countries and WHO regions</th>
<th>Number of countries and territories</th>
<th>Annual national TB report publicly available</th>
<th>National multisectoral and multistakeholder accountability and review mechanism, under high-level leadership available</th>
<th>Engagement of civil society and affected communities in the multisectoral accountability and review mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>High TB burden countries</td>
<td>30</td>
<td>29 (97%)</td>
<td>19 (63%)</td>
<td>15 (50%)</td>
</tr>
<tr>
<td>Africa</td>
<td>47</td>
<td>43 (92%)</td>
<td>31 (69%)</td>
<td>29 (62%)</td>
</tr>
<tr>
<td>Americas</td>
<td>45</td>
<td>24 (53%)</td>
<td>22 (49%)</td>
<td>11 (24%)</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>22</td>
<td>18 (82%)</td>
<td>14 (64%)</td>
<td>8 (30%)</td>
</tr>
<tr>
<td>Europe</td>
<td>54</td>
<td>34 (63%)</td>
<td>26 (49%)</td>
<td>17 (32%)</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>11</td>
<td>10 (91%)</td>
<td>10 (91%)</td>
<td>6 (55%)</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>36</td>
<td>28 (78%)</td>
<td>22 (61%)</td>
<td>16 (44%)</td>
</tr>
<tr>
<td>Total</td>
<td>215</td>
<td>157 (73%)</td>
<td>125 (58%)</td>
<td>87 (41%)</td>
</tr>
</tbody>
</table>

References


TB and diabetes

The provision of integrated and patient-centred care for people with tuberculosis (TB) and comorbidities, including for those with diabetes mellitus, is embedded within Pillar 1 of the End TB Strategy. In 2018, at the first United Nations (UN) high-level meeting on TB, Member States committed to developing community-based health services with integrated care for TB patients with related health conditions; for example, HIV, undernutrition, mental illness, and noncommunicable diseases (NCDs), including diabetes mellitus (1).

The prevalence of diabetes influences TB incidence and TB mortality. It is associated with a twofold to threefold risk of TB disease, a twofold risk of death during TB treatment, a fourfold risk of TB relapse after treatment completion and a twofold risk of multidrug-resistant TB (MDR-TB) (2-4). In 2020, an estimated 369 000 (UI: 262 000 - 494 000) new cases of TB were attributable to diabetes (Section 6.3). In 2019, just over 15% of people with TB were estimated to have diabetes globally, compared with 9.3% among the general adult population (aged 20-79 years) (5, 6). This equates to about 1.5 million people with TB and diabetes who required coordinated care and follow-up to optimize the management of both conditions.

Global burden of diabetes

The Global Health Observatory provides national estimates of the prevalence of diabetes in adults (Fig. 1). The median prevalence of diabetes in the 30 high TB burden countries according to latest available data was 8% (Interquartile range [IQR]: 6-9%), and was 10% or more in Gabon (10%), Mongolia (12%), Pakistan (12%), Papua New Guinea (15%) and South Africa (11%) (Fig. 1). The International Diabetes Federation estimates that the number of people with diabetes will increase by about 50% globally between 2019 and 2045, with a median increase in the high TB burden countries of 99% (IQR: 69-151%) (6).

Collaborative action to address TB and diabetes

Since 2011, in recognition of the link between TB and diabetes, the World Health Organization (WHO) has recommended collaborative care for people with TB and diabetes in the Collaborative framework for care and control of TB and diabetes (7). The framework of recommendations is organized around three objectives: establish mechanisms for collaboration, detect and manage TB in patients with diabetes, and detect and manage diabetes in patients with TB (Table 1). Key components of the framework include surveillance of the joint burden of TB and diabetes, and monitoring and evaluation of collaborative TB and diabetes activities. WHO does not currently request countries to report routine data about the joint burden of TB and diabetes or the implementation of TB and diabetes collaborative
activities. However, efforts are ongoing to assess the uptake of WHO policy and the joint burden of TB and diabetes.

To help with monitoring of progress in implementing people-centred care for TB and comorbidities since the UN high-level meeting on TB, WHO conducted a policy review in 2020. The review examined the extent to which national policies and guidelines in high TB burden countries aligned with WHO guidance for collaborative activities on TB and diabetes, and it focused on countries in the list of 30 high TB burden countries defined by WHO for 2016-2020. The review identified national TB strategic plans (NSPs) for all countries and 28 NSPs for NCDs, 55 national guidelines on TB (e.g. treatment guidelines, programmatic guidelines for the management of drug-resistant TB and the management of childhood TB), and three national frameworks for TB and diabetes. All documents were carefully reviewed to assess whether they described TB and diabetes collaborative activities. Based on this review, estimates were made of the number of countries adopting key recommendations on the screening and co-management of TB and diabetes within the respective NSPs for TB and NCDs, and within TB guidelines (Fig. 2).

Among the 30 high TB burden countries, 21 (70%) referred to the importance of TB screening among people with diabetes in at least one of their national documents. TB screening was featured in 18 (60%) NSPs for TB but was recommended in the national guidelines of only 15 (50%) countries. Overall, 20 (67%) countries referred to screening of diabetes in TB patients and 24 (80%) referred to management of diabetes in TB patients, but these topics had a limited profile in the NSPs for TB. Among the 24 (80%) countries that recommend diabetes management among people diagnosed with TB in their guidelines, nine (30% of the total) recommended it only for patients with MDR-TB. Only two (7%) countries (South Africa and United Republic of Tanzania) had plans for joint or bidirectional screening and co-management for TB and diabetes within their NSPs for NCDs.

Since 2017, countries in the WHO Region of the Americas have been asked to report on two indicators to monitor the burden of diabetes among people with a new or relapse episode of TB. These indicators are the number of TB patients tested for diabetes and the proportion of those tested who have diabetes. In 2020, 22 countries reported that they tested 47,041 people newly diagnosed with TB for diabetes, representing a median testing coverage rate of 55% (IQR: 13-92%). In the 13 countries that reported testing at least half of their TB patients for diabetes, the median diabetes prevalence was 13% (IQR: 11-20%).

These findings show that although WHO first recommended collaborative activities to address TB and diabetes in 2011, implementation is variable. Increased commitment to address the global burden of diabetes represents an opportunity for TB and NCD programmes to join forces to expand access to vital diagnosis and care necessary for people with TB and diabetes, and to optimize treatment outcomes (8). Monitoring and evaluation of the joint response will be critical for driving scale-up and for assessing
the impact of TB and diabetes collaborative activities. Countries are urged to determine the impact of diabetes on the TB response, to implement TB and diabetes collaborative activities and to monitor their success as part of surveillance activities, operational research or prevalence surveys.

**Fig. 1** The age-adjusted prevalence of diabetes, latest available data

<table>
<thead>
<tr>
<th>Percentage</th>
<th>0-5.9</th>
<th>6-9</th>
<th>10-13</th>
<th>14-16</th>
<th>&gt;16</th>
<th>No data</th>
<th>Not applicable</th>
</tr>
</thead>
</table>

*Source: WHO. Global Health Observatory [Link](https://www.who.int/data/gho/data/indicators/indicator-details/GHO/estimated-fasting-blood-glucose-(5-7-0-mmol-l-or-on-medication)(age-standardized-estimate)*

**Table 1. Activities outlined within the Collaborative framework for care and control of TB and diabetes**

<table>
<thead>
<tr>
<th>A. Establish mechanisms for collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1. Set up means of coordinating diabetes and TB activities</td>
</tr>
<tr>
<td>A.2. Conduct surveillance of TB disease prevalence among people with diabetes in medium and high-TB burden settings</td>
</tr>
<tr>
<td>A.3. Conduct surveillance of diabetes prevalence in TB patients in all countries</td>
</tr>
<tr>
<td>A.4. Conduct monitoring and evaluation of collaborative diabetes and TB activities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Detect and manage TB in patients with diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.1. Intensify detection of TB among people with diabetes</td>
</tr>
<tr>
<td>B.2. Ensure TB infection control in health care settings where diabetes is managed</td>
</tr>
<tr>
<td>B.3. Ensure high-quality TB treatment and management in people with diabetes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Detect and manage diabetes in patients with TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.1. Screen TB patients for diabetes</td>
</tr>
<tr>
<td>C.2. Ensure high-quality diabetes management among TB patients</td>
</tr>
</tbody>
</table>
**Fig. 2 Uptake of WHO recommendations on TB and diabetes by the 30 high TB burden countries in 2020**

<table>
<thead>
<tr>
<th>TB screening among people with diabetes</th>
<th>Diabetes screening among people with TB</th>
<th>Management of diabetes in people with TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB guidelines</td>
<td>National strategic plans for TB</td>
<td>National strategic plans for non-communicable diseases</td>
</tr>
<tr>
<td>National strategic plans for TB</td>
<td>National strategic plans for non-communicable diseases</td>
<td>National strategic plans and guidelines combined</td>
</tr>
</tbody>
</table>

TB: Tuberculosis; WHO: World Health Organization

**References**

WHO TB guidelines: recent updates

The World Health Organization (WHO) has a mandate to develop and disseminate evidence-based policy, norms and standards for tuberculosis (TB) prevention, diagnosis, treatment and care. Hence, the WHO Global TB Programme performs regular reviews of evidence and assessments of country needs for policy updates across the cascade of TB prevention and care. TB guidelines and operational handbooks are now organized under five modules: prevention, screening, diagnosis, treatment and comorbidities, vulnerable populations and people-centred care.

Updated WHO guidelines and handbooks published since the release of the Global tuberculosis report 2020 are summarized here by module, along with a summary of the key recommendations.

Screening

In March 2021, WHO released the WHO consolidated guidelines on tuberculosis. Module 2: Screening – systematic screening for tuberculosis disease (1). These guidelines include 17 new and updated recommendations for the screening of TB disease. Populations identified as priorities for TB screening include contacts of TB patients, people living with HIV, people exposed to silica, prisoners and other key populations. The following screening tools are recommended: symptom screening, chest radiography, computer-aided detection (CAD) software, molecular WHO-approved rapid diagnostic tests and testing for C-reactive protein. This is the first time that CAD has been recommended for use in interpreting chest radiography for TB.

The new guidelines are accompanied by the WHO operational handbook on tuberculosis. Module 2: Screening – systematic screening for tuberculosis disease (2). The handbook provides practical advice on how to put the guideline recommendations in place at the scale needed to achieve national and global impact. It is intended to support policy-makers and health professionals to choose the best approach to planning and implementing TB screening and active TB case-finding, depending on the context. The handbook provides a sound basis for the development or updating of national guidelines for TB screening according to the epidemiology of TB in different risk groups and the health care delivery system in the country. This will contribute to finding people with TB who may be missed by passive TB case detection and finding people with TB earlier in the course of their disease, thus reducing transmission, morbidity, mortality and financial hardship.
Diagnosis

In July 2021, WHO released the *WHO consolidated guidelines on tuberculosis. Module 3: Diagnosis – rapid diagnostics for tuberculosis detection 2021 update* (3). Three new classes of nucleic acid amplification test (NAAT) are now endorsed by WHO:

- moderate complexity automated NAATs, which are recommended for the initial detection of TB and resistance to rifampicin and isoniazid, providing more options for early diagnosis of TB and rifampicin-resistant TB but also addressing an important gap in the rapid diagnosis of isoniazid-resistant and rifampicin-susceptible TB;
- low complexity automated NAATs, which are recommended for the detection of resistance to isoniazid and second-line anti-TB agents, helping to improve access to testing of resistance to fluoroquinolones at peripheral level; and
- high complexity reverse hybridization-based NAATs, which are recommended for the detection of pyrazinamide resistance and are the first molecular tests for resistance to this drug.

The new recommendations on diagnostics are accompanied by a *WHO operational handbook on tuberculosis. Module 3: Diagnosis – rapid diagnostics for tuberculosis detection* (4). The handbook aims to facilitate the implementation of WHO guidelines by countries, technical partners and others involved in managing patients with TB and drug-resistant TB. It provides practical information on new and existing tests recommended by WHO and model diagnostic algorithms. The handbook also has step-by-step advice on implementing and scale-up of testing to achieve local and national impact, and an overview of budgetary considerations and information sheets for each of the newly recommended tests.

In June 2021, WHO released a *catalogue of Mycobacterium tuberculosis mutations* as a reference standard for the interpretation of mutations conferring resistance to all first-line and a variety of second-line TB drugs (5). The report summarises the analysis of over 38,000 isolates with matched data on whole genome sequencing and phenotypic drug susceptibility testing from over 40 countries for 13 anti-TB medicines. It lists over 17,000 mutations, their frequency and association with resistance and includes methods used, mutations identified and summaries of important findings for each drug. This resource will allow laboratories around the world to better interpret the genome sequencing results. The catalogue can also guide the development of new molecular drug susceptibility tests, including next-generation sequencing.
Treatment

In April 2021, WHO convened a guideline development group (GDG) to review data from a trial conducted in 13 countries that compared 4-month rifapentine-based regimens with a standard 6-month regimen in people with drug-susceptible TB (6). The GDG considered a 4-month regimen composed of rifapentine, isoniazid, pyrazinamide and moxifloxacin that met the non-inferiority criteria set in the trial protocol. The available evidence supports the use of this regimen as a possible alternative to the current standard 6-month regimen. The shorter regimen showed similar performance to the current standard regimen in terms of both efficacy and safety. The 4-month regimen – which is shorter, effective and all-oral – would be preferred by many patients, allowing faster cure and easing the burden on both patients and the health care system. However, implementation and uptake of the new regimen in the short to medium term will be more feasible if the cost of rifapentine is reduced and availability improved. A rapid communication presents key findings and considerations on the use of the 4-month regimen following the GDG assessment (7). The full guidelines will be finalized by the end of 2021 and will be incorporated under Module 4: Treatment of the consolidated guidelines and operational handbook.

Comorbidities, vulnerable populations and people-centred care

In May to June 2021, WHO convened a GDG to review updated evidence on the management of TB in children and adolescents (aged 0–9 and 10–19 years, respectively). A rapid communication that summarizes the main updates to guidance on the management of TB in children and adolescents was released by WHO in August 2021 (8). The communication includes new information about treatment decision algorithms, the use of Xpert MTB/RIF Ultra to diagnose pulmonary TB using gastric aspirate and stool specimens, a 4-month regimen to treat non-severe, drug-susceptible pulmonary TB, the use of bedaquiline and delamanid to treat drug-resistant TB, a shortened intensified regimen for TB meningitis, and optimal models of care for the delivery of child and adolescent TB services. The aim is to inform staff from ministries of health, technical partners and other stakeholders about the key findings, considerations and changes related to the diagnosis, treatment and care of TB for children and adolescents, to allow for planning at the country level. Based on the outcomes of the GDG meeting, detailed recommendations will be published as part of the WHO consolidated guidelines on tuberculosis. Module 5: Co-morbidities, vulnerable populations and people-centred care, alongside an operational handbook; both documents will be published by the end of 2021.

Refugees and other displaced populations in humanitarian emergencies face significant threats to health and survival, including poverty, crowded living conditions, undernutrition and poor access to health care. These conditions predispose people to an increased risk of TB infection and development of disease. WHO, in collaboration with the United Nations (UN) High Commissioner for Refugees (UNHCR) and the United States Centers for Disease Control and Prevention (US CDC), will shortly
release a field guide to address the challenge of TB in refugees. This guide will include new strategic approaches, guidance and innovations on TB prevention and care interventions in humanitarian crisis situations, to prevent and alleviate the suffering and deaths caused by TB among refugees and displaced populations. Its relevance is underlined by the continued large-scale population movements worldwide induced by conflict, poverty, natural disasters and a changing climate.

Other actions to support TB policy guidance

To exchange views on emerging areas where there is a need for global TB policy guidance, in March 2021, WHO convened a consultation on the translation of TB research into global policy guidelines, attended by scientists, public health experts, partners, civil society and countries (9).

In June 2021, WHO launched a TB Knowledge Sharing Platform to bring all WHO TB guidelines, operational handbooks and training material together in one place (10). In addition to the desktop site, the content is also available on applications for smartphones and tablet computers. It is envisaged that the Knowledge Sharing Platform will become the main portal for dissemination of WHO’s TB guideline-related content, ensuring that the latest guidance and implementation aids are available in one place.

Throughout the year, the Global TB Programme continued to update its repository of WHO recommendations relevant to TB care on its WHO endTB Guidelines website (11). The database provides health care workers, decision-makers, researchers and other users with an efficient way to search and locate the latest TB guidance based on their questions of interest, with built-in search, filter and cross-tabulate functions (12). The site also gives access to evidence to decision (EtD) frameworks, study citations, and summaries of findings, providing a transparent link to the data and GDG judgements underpinning each recommendation.

Find the WHO TB Guide on Google Play or the Apple App Store.
References
