# R&D for Tuberculosis

## How new tools can transform the fight

GHTC global health technologies coalition

**Tuberculosis (TB) has burdened humanity with symptoms including cough, fever, and emaciation for thousands of years.** Today it is the world's leading infectious disease killer: 10 million people fell ill from TB and 1.5 million died in 2018 alone. Yet only one low-efficacy TB vaccine exists, treatment takes months to years, and improved diagnostics designed specifically for low-resource settings are needed.

Meanwhile, growing resistance to available drugs is making the disease more deadly and difficult to treat. To end the epidemic, new technologies to prevent, treat, and diagnose TB are urgently needed.

**1.5** million
people die annually from TB

**$393,000**
treatment cost and productivity loss of MDR-TB patient in US

**45%**
treatment failure rate for MDR-TB

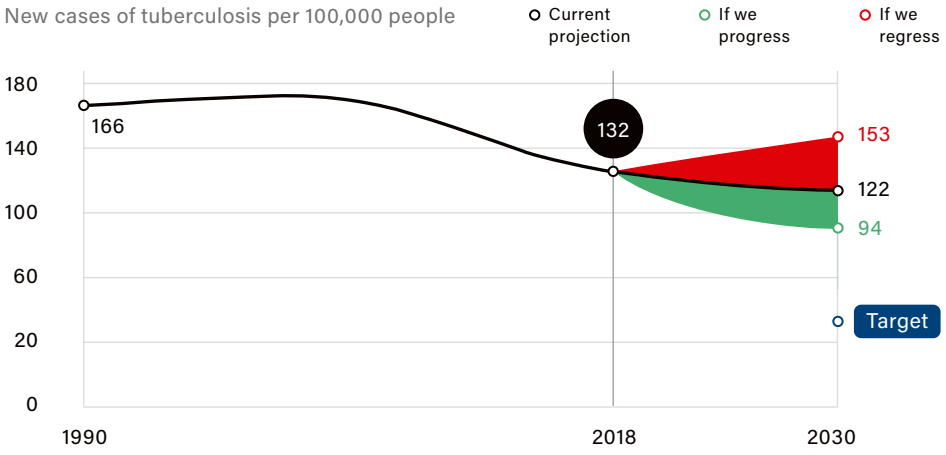
## **Research** successes

Technologies have transformed the fight against TB:

- The **first child-friendly TB medicines**, developed with support from USAID, were introduced in 2015. Appropriately-dosed, dissolvable, and fruit-flavored for palatability, they have transformed treatment for children, with over 1 million courses ordered in 93 countries.
- Bedaquiline, a **drug to combat multidrug-resistant TB** (MDR-TB), was approved by the FDA in 2012. Developed with early support from NIH, at the time it was the first new drug approved to treat TB in over 40 years.
- Pretomanid, a **new drug for highly drug-resistant TB**, developed with USAID and NIH support, was approved by the FDA in 2019 as part of a combination regimen with bedaquiline and linezolid. The regimen reduces treatment time from up to two years to six months, while significantly improving treatment outcomes.
- Xpert MTB/RIF, a **fully automated diagnostic test**, developed with NIH and DOD support, was introduced in the early 2010s. It is simple to use and produces results in two hours, compared to prior methods which took up to six weeks.
- 3HP, a **shorter preventative regimen** that can be taken weekly, rather than daily, to prevent latent TB from becoming active, was first introduced in 2011. Developed with CDC and NIH support, it is improving treatment completion.

## **Continued progress** is possible, not inevitable

New cases of tuberculosis per 100,000 people




## **Key** missing tools

To end TB, we need new tools to detect, prevent, and treat infection including:

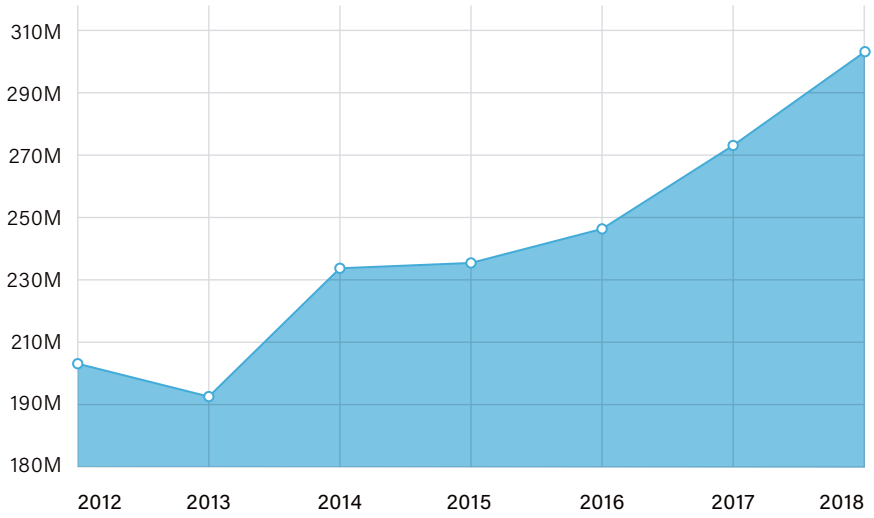
- **Shorter, simplified treatment regimens** for active TB to improve adherence and treatment outcomes and stem the rise of drug-resistant TB (DR-TB). Existing TB treatments can require thousands of pills and painful injections over the course of 6 to 20 months or longer, and certain drugs can cause severe side effects like liver damage and deafness.
- **Improved treatments for drug-resistant strains** to lower the mortality rate of MDR-TB and extensively drug-resistant TB, the deadliest and most difficult to treat forms of TB.
- **New vaccines** for prevention and treatment that are cost effective and address antimicrobial resistance (AMR). The TB vaccine currently is use was developed in 1921. Though effective at preventing some types of TB in infants, it offers inconsistent protection in adults against pulmonary TB, which affects the lungs.
- **Rapid, non-sputum-based diagnostics**, suitable for low-resource settings and primary healthcare facilities, as well as **rapid DR-TB tests** that enable treatment to be tailored to individuals and help safeguard against AMR.

## **Breakthroughs** on the brink

- A new **all-oral treatment regimen, BPaMZ**, developed with NIH and USAID support, is in late-stage clinical trials, with the goal of reducing treatment time for drug-sensitive TB from 6 months to 4 months and for MDR-TB from 9 to 24 months to 6 months. Beyond BPaMZ, **13 new TB drug compounds** are undergoing clinical trials.

- More than ten potential preventative and immunotherapeutic **TB vaccines** are in development, including a vaccine candidate, M72/AS01E, that prevented active pulmonary TB from developing in just over half the adults who received it in a phase 2 clinical trial.

US government investment in tuberculosis R&D (in 2018) US$ millions




- **New approaches and strategies for TB vaccine research** are invigorating the field, including research on new routes of administration, such as using inhaled aerosolized TB vaccines and new models for vaccine testing, such as the controlled human infection model, which exposes trial participants to a pathogen in a highly-controlled, safe environment.

- **New innovative methods to administer treatment** may lower the cost and burden of treatment by reducing the frequency and number of treatments that patients need. One example is a coiled wire device that slowly administers antibiotics into the stomach over several weeks, eliminating the need for daily oral pills.

- **A new point-of-care urine test** to detect TB in HIV-positive individuals is currently being evaluated, while subsequent iterations of the test for use in broader populations are in development. DNA-based tests, including **next-generation sequencing**, and digital tools, including **computer-assisted X-rays**, are also in development, which could more quickly detect and differentiate strains of TB and MDR-TB, leading to faster and more appropriate treatments for patients.

## **US Government** R&D efforts

The US government is leading efforts to advance research and development (R&D) to end the TB epidemic through a whole-of-government approach:

- **National Institutes of Health** conducts basic, translational, and clinical research to accelerate the development of new tools to diagnose, prevent, and treat TB.

- **US Agency for International Development** supports R&D for new TB diagnostics and drugs. The agency also works with CDC and NIH to support basic and applied R&D for MDR-TB as part of the National Action Plan for Combating Multidrug-Resistant Tuberculosis.

- **Centers for Disease Control and Prevention** supports clinical and epidemiological research for TB through national and international partnerships such as the TB Trials Consortium, which has supported the development and implementation of new TB technologies and significantly improved global TB treatment and prevention guidelines.

- **Department of Defense** has funded research on TB vaccines, drugs, and diagnostics through the Congressionally Directed Medical Research Programs.

- **Food and Drug Administration** administers the Tropical Disease Priority Review Voucher Program to incentivize investment in products for neglected diseases, including TB, and implements an expedited approval pathway for antibiotics that can apply to DR-TB products.



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