



# Tuberculosis (TB) Epidemiology : *A Worldwide Ancient Problem of Public Health*

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## *Definition of Epidemiology :*

Many definitions have been proposed, but the following definition captures the underlying principles and public health spirit of Epidemiology :

***Epidemiology is the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems.***

***Phase 2 lecture, 2024 - 2025***

***academic year, spring semester***

***21st April 2025 Ankara - TURKIYE***

TB remains the world's deadliest infectious disease, responsible for over 1 million deaths annually bringing devastating impacts on families & societies.

# Global tuberculosis report 2024

<https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2024>

# Learning Objectives

□ At the end of this TB Epidemiology lecture, you will be able to :

- **Define** TB Epidemiology and related key concepts
- **Describe** basic terminology and concepts of TB Epidemiology
- **Identify** types of data sources for TB Epidemiology
- **Identify** basic methods of data collection and interpretation for TB
- **Describe** a public health problem in terms of «**Time, Place, & Person triad**» for TB Epidemiology
- **Identify** the types of Epidemiologic research; Odd's ratio, relative risk, confidence interval.. for TB
- **Conceive** the vital role of Epidemiology in diagnosing & solving TB problem both in clinical practice and particularly in public health field.

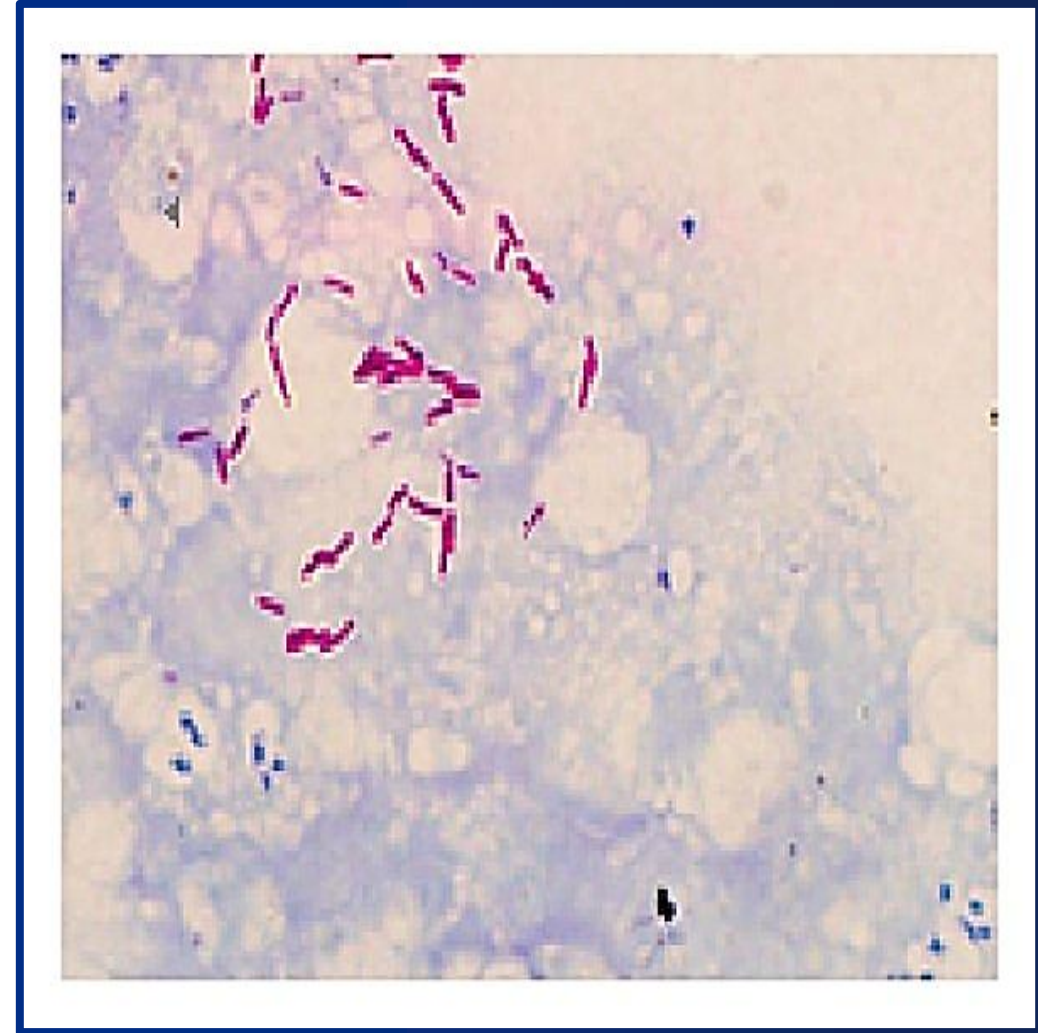


## □ Etiology & definition

- TB is caused by the bacillus *Mycobacterium tuberculosis*, which is spread when people who are sick with TB expel bacteria into the air (e.g. by coughing, sneezing).
- *About ¼ of the **global population** is estimated to have been infected with TB, but most people will not go on to develop TB disease and some will clear the infection .*
- Of the total number of people who develop TB each year, about 90% are adults, with more cases among men than women. The disease typically affects the lungs (*pulmonary TB*) but can affect other sites as well such as kidneys...

## TB can affect anyone!

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



Global Tuberculosis Report-2022, WHO

## ➤ General remarks :

- *About 1/4 of the world's population is infected with TB bacteria. Only small proportion of those infected will become sick with TB.*
- ✓ People with weakened immune systems have a much greater risk of falling ill from TB. A person living with **HIV** is about 13 times more likely to develop active TB.
- ❖ *WHO **End TB Strategy**, adopted by the World Health Assembly in May 2014, is a blueprint for countries to end the TB epidemic by driving down TB deaths, incidence & eliminating catastrophic cost.*
- It outlines global impact targets to reduce TB deaths by 90% and to cut new cases by 80% between 2015-30, and to ensure that no family is burdened with catastrophic costs due to TB.

# Epidemiology

**Epidemiology** is a scientific discipline with sound methods of scientific inquiry at its foundation.

**Epidemiology** is data-driven and relies on a systematic and unbiased approach to the collection, analysis, and interpretation of data.

**Basic Epidemiologic methods** tend to rely on careful observation and use of valid comparison groups to assess whether what was observed, such as the number of cases of disease in a particular area during a particular time period or the frequency of an exposure among persons with disease, differs from what might be expected.

However, **Epidemiology** also draws on methods from other scientific fields, including Biostatistics and Informatics, with biologic, economic, social, and behavioral sciences.

# Epidemiology

In fact, **Epidemiology** is often described as the basic science of Public Health, and for good reason.

First, **Epidemiology** is a quantitative discipline that relies on a working knowledge of probability, statistics, and sound research methods.

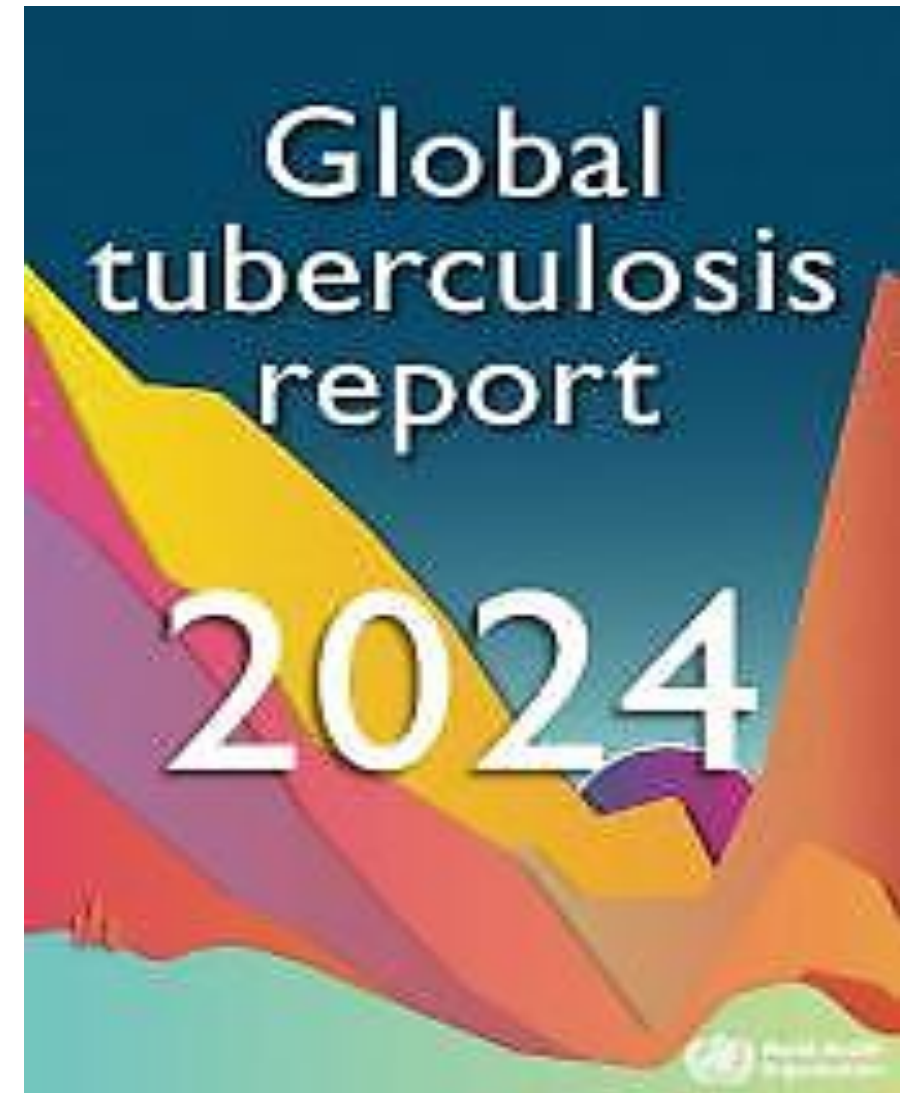
*Second, Epidemiology is a method of causal reasoning based on developing and testing hypotheses grounded in such scientific fields as biology, behavioral sciences, physics, and ergonomics to explain health-related behaviors, states, and events.*

However, **Epidemiology** is not just a research activity but an integral component of Public Health, providing the foundation for directing practical and appropriate Public Health action based on this science and

causal reasoning, **Causal relationship.**



In 2023, the UN held its 2nd high-level meeting on TB, elevating discussion about the status of the **TB epidemic** and how to end it to the level of heads of state and government. *The resulting political declaration reaffirms existing commitments and targets and includes new ones for the period 2023-27.*



<https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2024>

1. Ischaemic heart disease

2. COVID-19

3. Stroke

4. Chronic obstructive pulmonary disease

5. Lower respiratory infections

6. Trachea, bronchus, lung cancers

7. Alzheimer disease and other dementias

8. Diabetes mellitus

9. Kidney diseases

10. Tuberculosis

# Leading causes of death in 2021 globally

Number of deaths (in millions)

- 2000
- 2019
- 2021

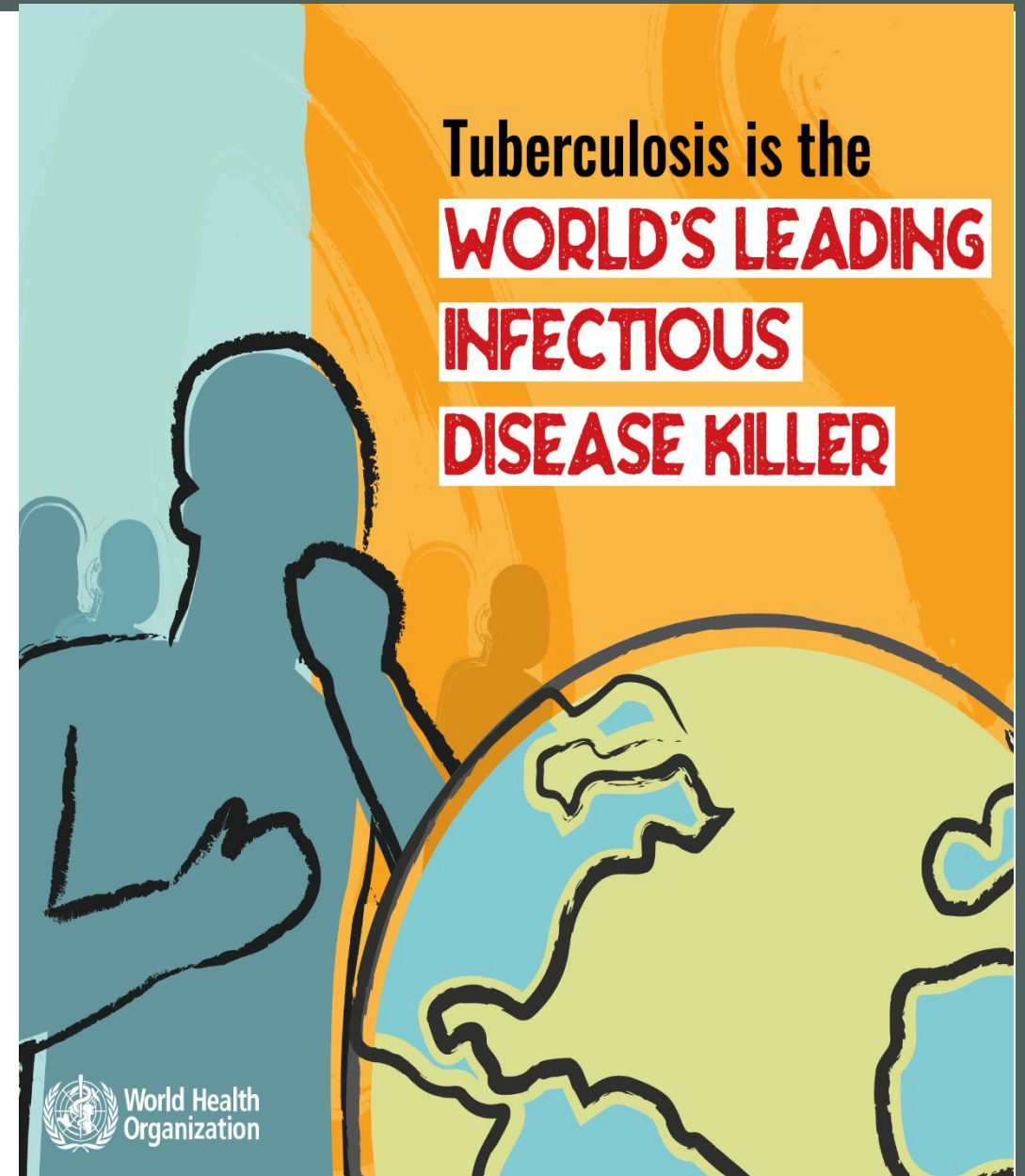
- Communicable, maternal, perinatal and nutritional conditions
- Injuries
- Noncommunicable diseases

Ref. [The top 10 causes of death](#) 20.4.25

In 2023, an estimated 10.8 million people fell ill with TB worldwide, including 6.0 million men, 3.6 million women and 1.3 million children and young adolescents.

*TB is present in all countries and age groups.*

***TB is curable and preventable.***



## WHO calls for urgent action to address worldwide disruptions in TB services putting millions of lives at risk

- Global efforts to combat TB have saved an estimated 79 million lives since 2000.
- *However, the drastic and abrupt cuts in global health funding happening now are threatening to reverse these gains.*
- Rising drug resistance especially across Europe and the ongoing conflicts across the Middle-East, Africa and Eastern Europe, are further exacerbating the situation for the most vulnerable.

<https://www.who.int/news/item/20-03-2025-who-calls-for-urgent-action-to-address-worldwide-disruptions-in-tuberculosis-services-putting-millions-of-lives-at-risk> 20.2.25

# WHO calls for urgent action to address worldwide disruptions in TB services putting millions of lives at risk

20 March 2025 News releases on World Tuberculosis (TB) Day, marked on **24 March**, the World Health Organization (WHO) is calling for an urgent investment of resources to protect and maintain tuberculosis (TB) care and support services for people in need across regions and countries.

*TB remains the world's deadliest infectious disease,  
responsible for over 1 million deaths annually  
bringing **devastating impacts on families and communities.***

# WHO calls for urgent action to address worldwide disruptions in TB services putting millions of lives at risk

- Under the theme **Yes! We Can End TB**: Commit, Invest, Deliver, [World Tuberculosis Day 2025](#) campaign highlights a rallying cry for urgency, and accountability and hope.
- *The huge gains the world has made against TB over the past 20 years are now at risk as cuts to funding start to disrupt access to services for prevention, screening, and treatment for people with TB,” said Dr. Ghebreyesus, WHO Director-General.*
- “But we cannot give up on the concrete commitments that world leaders made at the UN General Assembly just 18 months ago to accelerate work to end TB.
- *WHO is committed to working with all donors, partners and affected countries to mitigate the impact of funding cuts and find innovative solutions.”*

<https://www.who.int/news/item/20-03-2025-who-calls-for-urgent-action-to-address-worldwide-disruptions-in-tuberculosis-services-putting-millions-of-lives-at-risk> 20.2.25

We emphasize the importance of keeping the world safe from TB, and ensuring an equitable and sustainable response towards ending TB. In the current context, we call on all stakeholders to take urgent action to

1. Prevent any disruption of TB services with a sense of urgency, initiating a response commensurate to the disruption.
2. *Ensure domestic resources to sustain equitable and essential TB care.*
3. Safeguard the key activities, essential TB drugs, diagnostics, care and **social protection** coverage for people with TB, while strengthening **collaboration** with other stakeholders within and beyond the health sector.

[https://cdn.who.int/media/docs/default-source/hq-tuberculosis/documents/who-director-general-and-civil-society-task-force-on-tb-release-joint-statement-on-sustaining-the-momentum-to-end-tb.pdf?sfvrsn=d8e1e059\\_3\\_20.2.25](https://cdn.who.int/media/docs/default-source/hq-tuberculosis/documents/who-director-general-and-civil-society-task-force-on-tb-release-joint-statement-on-sustaining-the-momentum-to-end-tb.pdf?sfvrsn=d8e1e059_3_20.2.25)

We emphasize the importance of keeping the world safe from TB, and ensuring an equitable and sustainable response towards ending TB. In the current context, we call on all stakeholders to take urgent action to:

4. Establish or activate national partner platforms including public and private sectors, çivil society, NGOs, professional societies, donors, in all countries affected by services disruptions, to maintain momentum towards **ending TB** and tackle financial and operational uncertainties.

*5. Enhance monitoring by increasing reporting frequency to better assess impact and establish early warning systems.*

[https://cdn.who.int/media/docs/default-source/hq-tuberculosis/documents/who-director-general-and-civil-society-task-force-on-tb-release-joint-statement-on-sustaining-the-momentum-to-end-tb.pdf?sfvrsn=d8e1e059\\_3\\_20.2.25](https://cdn.who.int/media/docs/default-source/hq-tuberculosis/documents/who-director-general-and-civil-society-task-force-on-tb-release-joint-statement-on-sustaining-the-momentum-to-end-tb.pdf?sfvrsn=d8e1e059_3_20.2.25)



# Key facts-1

- A total of 1.25 million people died from tuberculosis (TB) in 2023 (including 161 000 people with **HIV**).
- *Worldwide, TB has probably returned to being the **World's leading cause of death from a single infectious agent**, following three years in which it was replaced by coronavirus disease (COVID-19).*
- It was also the leading killer of people with HIV and a major cause of deaths related to **antimicrobial resistance-AMR**.
- *In 2023, an estimated 10.8 million people fell ill with TB worldwide, including 6.0 million men, 3.6 million women and 1.3 million children.*
- TB is present in all countries and age groups.
- ***TB is curable and preventable.***

# Key facts-2

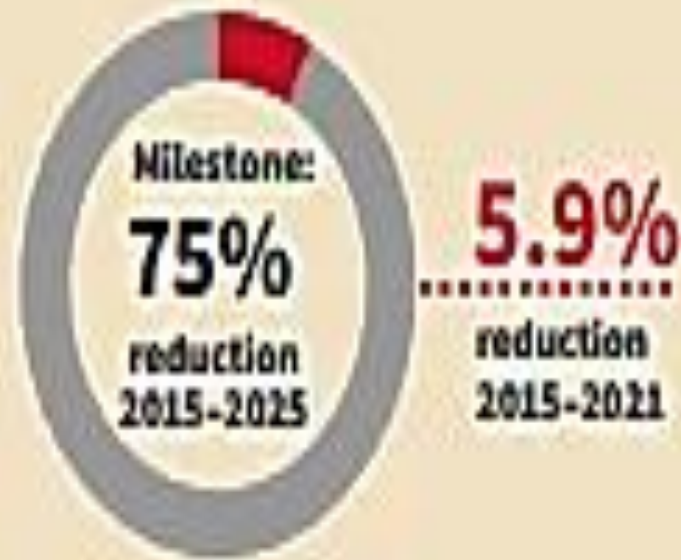
- ***Multidrug-resistant TB (MDR-TB) remains a public health crisis*** and a health security threat.
- Only 2/5 people with drug resistant TB accessed treatment in 2023.
- Global efforts to combat TB have saved an estimated 79 million lives since the year 2000.
- *US\$ 22 billion is needed annually for TB prevention, diagnosis, treatment and care to achieve the global target by 2027 agreed at the 2023 UN high level-meeting on TB.*
- **Ending the TB** epidemic by 2030 is among the health targets of the UN Sustainable Development Goals (SDGs).

# WHO End TB Strategy: 2025 milestones

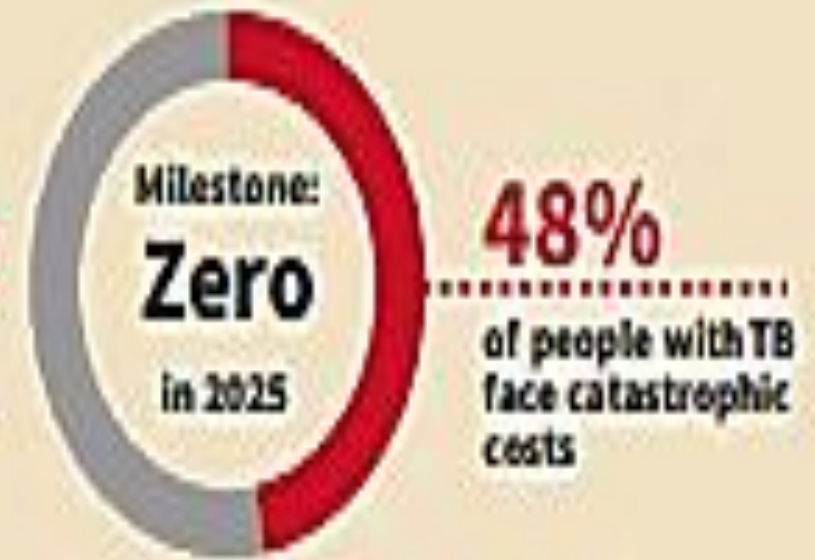
## TB INCIDENCE RATE



## NUMBER OF TB DEATHS



## PERCENTAGE OF PEOPLE WITH TB FACING CATASTROPHIC COSTS\*



## What Are the Symptoms of TB?

❖ TB symptoms usually develop slowly and may not be noticeable for months. Common signs include:

- *Persistent cough lasting more than 2 weeks*
- *Coughing up blood or sputum*
- *Night sweatstel: +90 850 288 38 38*
- *Fever and fatigue*
- *Loss of appetite and weight loss*
- *Chest pain and shortness of breath*



❑ These symptoms can be mistaken for other diseases, so it's important to seek medical advice if they persist.

[https://healthturkiye.com/tuberculosis-\(tb\)](https://healthturkiye.com/tuberculosis-(tb)) 20.4.25

# How Is TB Transmitted?

- TB is primarily spread through the air. When an infected person coughs, sneezes, or talks, **tiny droplets containing TB bacteria** are released into the air. When others breathe in these droplets, they may become infected.
- *However, being infected with the TB bacteria does not necessarily mean that the person will become ill. The body's immune system can suppress the bacteria, resulting in what is known as latent TB infection. These individuals are not contagious, but if their immune system weakens, the disease can become active.*

## ❑ Factors that increase the risk of TB transmission include:

- Living in close contact with an infected person
- Spending time in crowded, poorly ventilated areas
- Having a ***weakened immune system*** (due to HIV, cancer treatments, old age, etc.)
- Malnutrition and **poor living conditions** [https://healthturkiye.com/tuberculosis-\(tb\)](https://healthturkiye.com/tuberculosis-(tb)) 20.4.25

# Prevention and Vaccination

- One of the most effective ways to control TB is early diagnosis and treatment. Isolating infectious patients and screening close contacts can help prevent the spread.
- ***The BCG vaccine*** is also widely used for TB prevention. It offers protection, especially in children, against severe forms of the disease. In Türkiye, the BCG vaccine is part of the routine immunization schedule for newborns.
- **To prevent TB:**
  - Avoid prolonged time in crowded, poorly ventilated areas
  - *Eat a balanced diet to strengthen your immune system*
  - Stay up to date with **vaccinations**
  - See a doctor if you have symptoms such as a ***long-lasting cough***

[https://healthturkiye.com/tuberculosis-\(tb\)](https://healthturkiye.com/tuberculosis-(tb)) 20.4.25

# Diagnosis and Treatment

❑ TB is diagnosed through a combination of symptoms, physical examination, laboratory tests, and imaging methods. Common diagnostic tools include:

• *Sputum smear microscopy*

*Chest X-ray*

• *Tuberculin skin test (PPD test)*

*PCR and culture tests*

❑ Once diagnosed, treatment begins. *TB treatment usually lasts six months* and involves a combination of antibiotics. The drugs must be taken regularly and in the prescribed combinations to be effective.

❑ Adherence to treatment is crucial for successful recovery. Inconsistent or incomplete treatment can lead to **drug-resistant TB strains**, making the disease much harder to treat and increasing the risk of further spread.

[https://healthturkiye.com/tuberculosis-\(tb\)](https://healthturkiye.com/tuberculosis-(tb)) 20.4.25



T.C. SAĞLIK BAKANLIĞI

## Ulusal Tüberküloz Kontrol Programı



Turkish Republic  
Ministry of Health  
**NATIONAL  
TUBERCULOSIS  
CONTROL  
PROGRAMME**

Ankara, 2022

20.04.2025

- **Directly Observed Treatment Short Course (DOTS)** created new hopes for eradication in Africa, with a significant decrease from 2005. *Turkiye* also implemented these strategies and jointly with *WHO*, *DOTS* started in 2002.
- Despite these strategies, we are still far from the **WHO 2050 target** of one case in a million.
- Currently, the infection rate with **multidrug resistant TB** (MDR-TB) in sub-Saharan Africa and former Soviet Union (FSU) countries is extremely concerning.

Ref. Cengiz Cavusoglu, Ege University. History of tuberculosis and **tuberculosis control program in Turkey**, January 2014 *Microbiology Australia* 35(3):169  
DOI:10.1071/MA14056

## What is DOTS?

- **D.O.T.S** stands for **Directly-Observed Treatment Shortcourse**.
- It is a comprehensive strategy endorsed by the **World Health Organization (WHO)** and **International Union Against Tuberculosis and Lung Diseases (IUATLD)** to detect and cure **TB patients**.





T.C. SAĞLIK BAKANLIĞI

## Ulusal Tüberküloz Kontrol Programı



Turkish Republic  
Ministry of Health  
NATIONAL  
TUBERCULOSIS  
CONTROL  
PROGRAMME

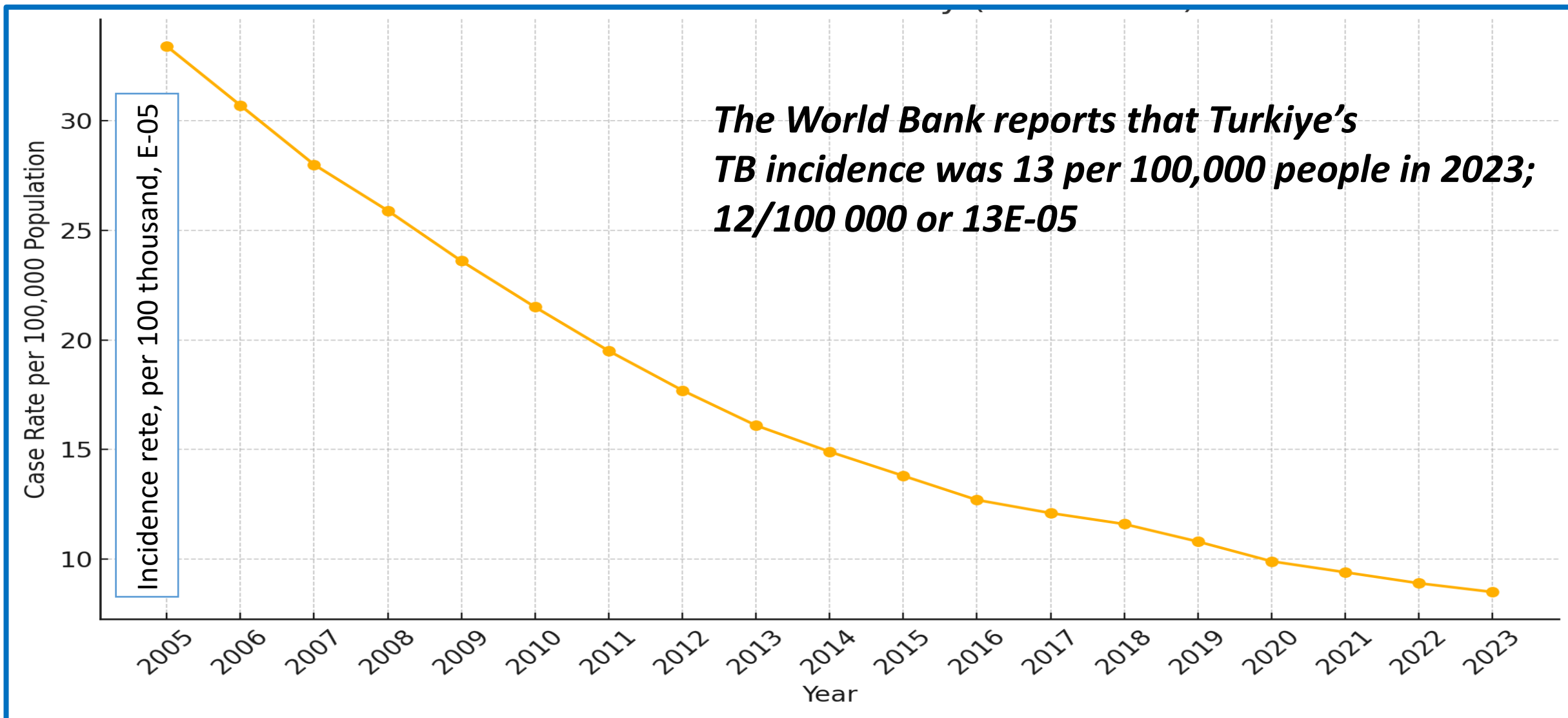
Ankara, 2022

## TB Control Efforts in Türkiye

- Türkiye has made significant progress in the fight against TB.
- TB diagnosis and treatment are offered free of charge through government-supported TB control centers.
- These centers also monitor patients, trace contacts, and provide public education.
- However, new challenges like **drug-resistant TB** and the movement of **large populations due to migration** make continuous effort necessary.
- Health worker training, public awareness, and access to care are essential in maintaining control.

[https://healthturkiye.com/tuberculosis-\(tb\)](https://healthturkiye.com/tuberculosis-(tb)) 20.4.25

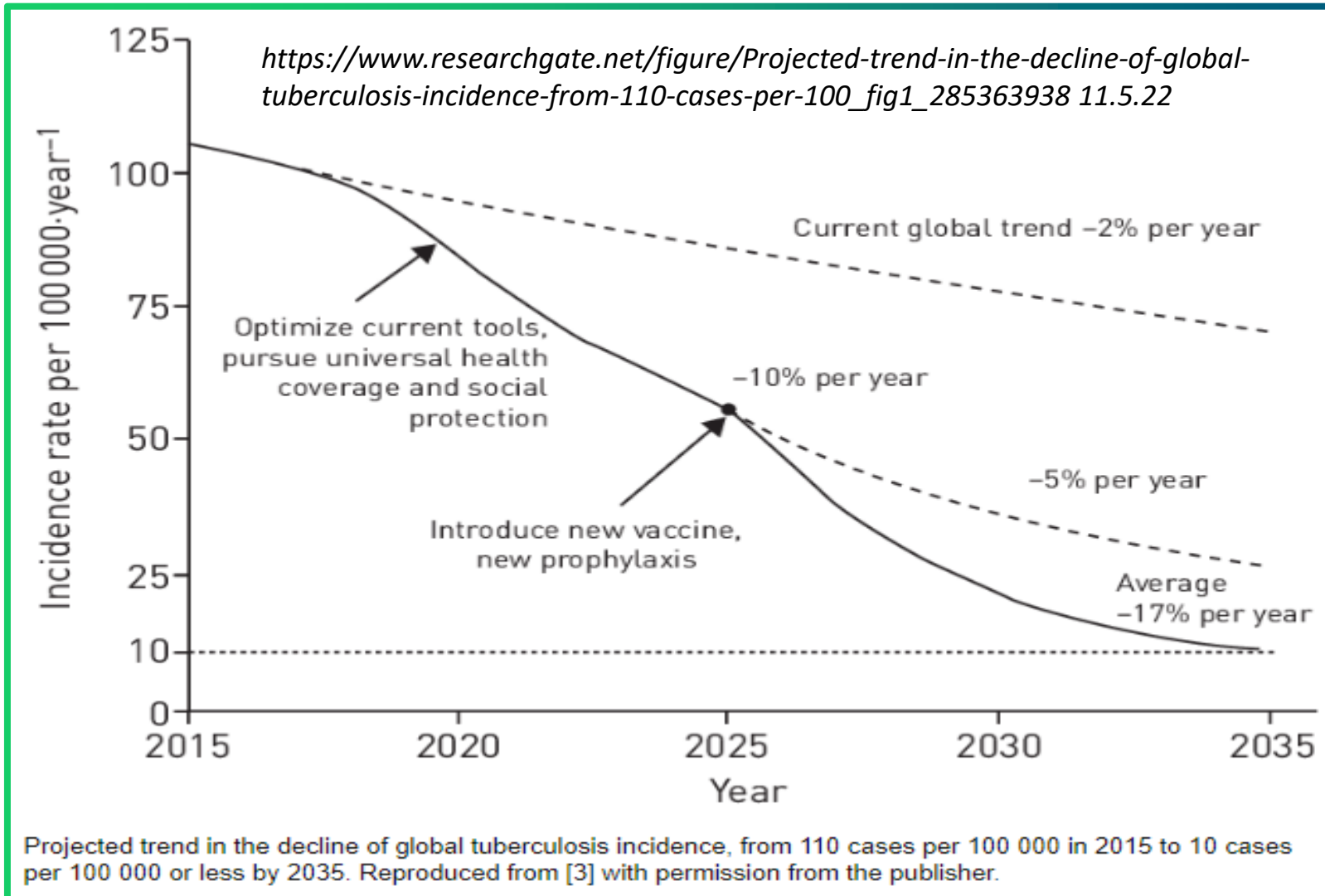
# Total TB Case Rate in Turkiye by Years, 2005-2023



Turkish Republic Ministry of Health, NATIONAL TUBERCULOSIS CONTROL PROGRAMME



# Projected trend in the decline of *global tuberculosis incidence*



- ❖ The prospect of **TB elimination** in low-incidence countries in a foreseeable future.
- ❖ *If the scientific community stay focussed on innovative approaches that can translate into scalable and **effective interventions**, we could reap the benefits of such interventions within the space of the next two decades.*

# Anyone can get TB, but some people are at greater risk of TB than others



- TB disproportionately affects some groups depending on various demographic, health, and ***social factors***.
- In 2020, the majority of persons with TB disease in the US identified as
  - Non-Hispanic Asian persons; 35.8%,
  - Hispanic persons; 29.7%,
  - Non-Hispanic Black persons; 19.6%,
  - or Non-Hispanic White persons; 11.0%.

Source: *TB by Race/Ethnicity: 1993–2020*

<https://www.cdc.gov/tb/statistics/tbcases.htm>

# Multidrug-resistant TB (MDR-TB)

Drug resistance emerges when TB medicines are used inappropriately, through ***incorrect prescription by health care providers***, poor quality drugs, or patients stopping treatment prematurely.

**MDR-TB** is a form of TB caused by bacteria that do not respond to *isoniazid-INH* and Rifampicin, the two most effective first-line TB drugs.

**MDR-TB** is treatable and curable by using other drugs, which tend to be more expensive and toxic.

In some cases, **extensively drug resistant TB or XDR-TB** can develop. TB caused by bacteria that do not respond to the most effective drugs in MDR-TB treatment regimens can leave patients with very limited treatment options.

# Multidrug-resistant TB (MDR-TB)

- MDR-TB remains a **public health crisis** and a health security threat.
- Only about 2/5 people with multidrug resistant TB accessed treatment in 2023.
- **WHO guidelines** : *Detection of MDR-TB requires bacteriological confirmation of TB and testing for drug resistance using rapid molecular tests or culture methods.*
- **New WHO guidelines** prioritized **a short 6-month all-oral regimen** known as BPaLM/BPaL (*Bedaquiline, Pretomanid, Linezolid, Moxifloxacin*) as a treatment of choice for eligible patients.
- *The shorter duration, lower pill burden and high efficacy of this novel regimen can help ease the burden on health systems and save precious resources to further expand the diagnostic and treatment coverage for all individuals in need.*
- In the past, MDR-TB treatment used to last for at least 9 months & up to 20 months. **WHO recommends expanded access to all-oral regimens.**

# PRINCIPLES of TB Fighting-1

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

## **INTEGRATED, PATIENT-CENTRED CARE AND PREVENTION**

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



# PRINCIPLES of TB Fighting-2

## BOLD POLICIES AND SUPPORTIVE SYSTEMS

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

## INTENSIFIED RESEARCH AND INNOVATION

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

# Prevention tools

In regards to *effective preventive interventions*, a safe and effective *M. tuberculosis vaccine* is not available despite intense research efforts over the past 2 decades. The current *Bacille Calmette–Guérin (BCG) vaccine* in use today *does not prevent infection but may reduce mortality in young recipients*.

BCG has been implemented for nearly a century, and despite its widespread use, *TB continues to be a major global problem*. A vaccine to prevent *M. tuberculosis* infection or disease remains an important tool for **elimination**, but the development of such a vaccine is considerably hindered by the complex biology of *M. tuberculosis* and the lack of basic information on protective immune responses.

# Prevention-1

**Follow these steps to help prevent tuberculosis infection and spread:**

- Seek medical attention if you have symptoms like ***prolonged cough, fever and unexplained weight loss*** as early treatment for TB can help stop the spread of disease and improve your chances of recovery.
- Get tested for TB if you are at increased risk, such as if you have **HIV** or are in contact with people who have ***TB in your household or workplace.***

# Prevention-2

**Follow these steps to help prevent tuberculosis infection and spread:**

- TB *preventive treatment* (or TPT) prevents infection from becoming disease.
- If prescribed TPT, **complete the full course regularly.**
- If you have TB, practice good **hygiene** when **coughing**, including avoiding contact with other people and **wearing a mask**, **covering your mouth and nose** when coughing or sneezing, and **disposing of sputum and used tissues properly.**
- Special measures like respirators and ventilation are important to reduce infection in healthcare facilities and other institutions.*

# TB Problem in Turkiye among irregular immigrants-1

Let us state that *March 24 is the World War Against Tuberculosis Day* to raise awareness and take the necessary precautions for tuberculosis, for which Turkiye has been successful in the fight and has become an exemplary country.

Referring to the discovery of *Mycobacterium tuberculosis*, the causative agent of Tuberculosis, by **Robert Koch** on March 24, 1882, and with the recommendation of **WHO**, March 24 has been celebrated since 1996, with various events, to draw attention to the

**devastating health, social and economic consequences of tuberculosis**

and to raise public awareness about the disease.

# TB Problem in Turkiye among irregular immigrants-2

TB has decreased considerably with the "***war on tuberculosis***", which is one of the important breakthroughs made in the field of health in our country with the establishment of the **Turkish Republic**.

However, with the ***COVID-19 pandemic***, there is an increase in Turkiye as well as in the rest of the world.

Especially in recent years, our country has been subjected to an ***influx of uncontrolled immigrants*** and a significant part of the cases have been detected in this segment, which draws attention to the negative effects of the **immigrant problem** on health as well as other social and economic problems.

# Eradication : *Pre-conditions*

There are **3 major pre-conditions** that make it scientifically more feasible to **eradicate** a disease:

**(1) epidemiological vulnerability,**

**(2) effective interventions, and**

**(3) feasibility of elimination.**

For TB, the disease is not vulnerable to eradication for the following reasons:

It is easily transmitted; transmission occurs throughout the year and is not linked to a cyclical disease cycle (e.g., like influenza); there is no natural immunity to prevent re-infection; it is not easily diagnosed (current estimates from the ***WHO suggest that nearly 1/3 of all TB cases are not detected***); disease relapse is documented in a proportion of patients who complete treatment; and there is an LTBI reservoir that can re-activate at any time in an individual's lifetime. In addition, **TB elimination** has never been documented from any country in the world, indicating that the likelihood of achieving global TB eradication is low.

# Eradication

In theory, if adequate **funding**, appropriate tools, and political commitment were available, all infectious diseases including **TB would be eradicable.**

*The important indicators of eradicability include the availability of effective interventions, including practical, affordable, and implementable diagnostics, prevention tools, treatment, and adequate funding.*

To date, only **smallpox** and **rinderpest** have been successfully eradicated.

*Both diseases had these tools available, coupled with serious political commitment to effectively interrupt transmission and reduce prevalence to zero.*

Currently, six ongoing programs are in progress: **Poliomyelitis, Yaws, Dracunculiasis, Malaria, Hookworm, and Yellow Fever.** In addition, the International Task Force for Disease Eradication at the Carter Center has identified *neonatal tetanus, leprosy, onchocerciasis, trachoma, and lymphatic filariasis* as additional potential candidates for elimination.



# Conclusion

- ❖ There is a need to differentiate the development of new technologies, including the endorsement, adoption, and scale-up, from the **training**, implementation, and health systems challenges on a global scale.
- ❖ Although significant progress has been made in the fight against TB over the last 25 years, significant challenges remain and much greater political and **funder investment** is still needed *to achieve global elimination*.



We have before us the opportunity to save the lives of millions, to preserve resources and to demonstrate the success of efforts **to end TB**, despite crises that come our way.

We must keep the momentum going to stop the spread of this **preventable and curable disease** and reach those affected with the care they need. We are running out of time the clock is ticking.

**It's time for urgent action to End TB.**



*Thanks for  
cooperation*