Global Tuberculosis Burden Trends (2000–2024)

Evaluating Detection Efficiency Across WHO Regions

Sector: Public Health Analytics

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Executive Summary

Tuberculosis (TB) remains one of the leading infectious diseases globally. Although global efforts have contributed to a gradual decline in TB incidence over the last two decades, the burden remains uneven across WHO regions.

This report analyzes TB burden trends from 2000 to 2024 using WHO Tuberculosis Burden Estimates. The objective is to examine long-term incidence patterns and assess how detection rate improvements relate to regional TB outcomes.

Dashboard analysis shows that global TB incidence has declined from 2000 to 2024, with an overall reduction of approximately 47.9%. Mortality trends also demonstrate a substantial decline during the same period. However, regional differences remain significant, with the South-East Asia (SEA) and African (AFR) regions continuing to carry higher incidence levels compared to Europe (EUR) and the Americas (AMR).

The findings suggest that regions with relatively stronger detection performance tend to demonstrate more stable incidence reduction patterns. Strengthening detection systems and improving regional surveillance remain important components of TB control strategy.

Sector & Policy Context

Tuberculosis remains among the leading infectious causes of mortality worldwide. Global eradication initiatives led by the World Health Organization (WHO) have focused on early detection, standardized treatment protocols, and integrated TB-HIV management strategies.

Despite these efforts, systemic challenges persist:

- Under-detection in resource-constrained regions
- Delayed diagnosis due to limited screening infrastructure
- Uneven healthcare access across regions
- TB-HIV co-infection amplifying disease burden

Public health policy increasingly emphasizes detection efficiency as a foundational driver of incidence reduction. Strengthening surveillance systems not only improves case identification but also interrupts transmission cycles. This project evaluates whether these detection improvements have translated into measurable epidemiological progress.

Problem Statement & Objectives

Problem Statement

To evaluate whether improvements in TB detection systems between 2000 and 2024 have contributed to sustained reductions in TB incidence across WHO regions.

Project Scope

- Global longitudinal TB dataset (2000–2024)
- Regional comparative analysis
- Detection rate assessment
- Correlation between Detection Rate and TB Incidence

Objectives

- Examine long-term TB incidence trends
- Analyze detection rate progression
- Quantify the relationship between detection efficiency and incidence • Identify regional performance disparities
- Derive actionable policy insights

Data Description

Data Source

WHO Tuberculosis Burden Estimates Dataset (2000–2024).

(Source, download)

Coverage

- Time Period: 2000–2024
- Geographic Scope: Global, segmented by WHO regions
- Data Level: National-level aggregated estimates

Key Variables

- TB Incidence (per 100,000 population)
- Detection Rate
- TB Death Rate
- TB-HIV Incidence
- Population

The dataset provides longitudinal epidemiological indicators enabling trend evaluation and regional benchmarking.

Data Cleaning & Preparation

All data preparation steps were conducted in Google Sheets in compliance with capstone requirements.

Cleaning Steps

- Identification and treatment of missing values
- Standardization of year formatting
- Verification of rate normalization per 100,000 population
- Derivation of supporting calculated indicators

Assumptions

- WHO data reporting standards are consistent across years
- Population estimates are reliable
- Missing values reflect reporting gaps rather than zero incidence

KPI Metrics and Framework

KPI	Formula	Policy relevance
Global TB Incidence Change (2000–2024)	**(Average Incidence in 2024 – Average in 2000) ÷ Average in 2000**	Tracks global progress in reducing TB spread
Global TB Mortality Change (2000–2024)	**(Average Death Rate in 2024 – Average in 2000) ÷ Average in 2000**	Measures how much TB fatality has declined due to interventions
Global Avg TB Incidence (2024)	**=AVERAGEIFS([Incidence Column], [Year Column], 2024)**	Highlights current global TB burden
Global Avg TB Death Rate (2024)	**=AVERAGEIFS([Death Rate Column], [Year Column], 2024)**	**I**ndicates how fatal TB is in 2024, guides treatment effectiveness
Average Fatality Rate (2024)	**=AVERAGEIFS([Fatality Column], [Year Column], 2024)**	Identifies regions with poor health outcomes
Detection Gap (2024)	**=100 – AVERAGEIFS([Detection Rate Column], [Year Column], 2024)**	Shows % of TB cases likely missed — a key intervention target
Highest Burden Region (2024)	**Region with MAX(Average Incidence) from regional pivot**	Directs focus to regions with the most active TB transmission

Lowest Detection Region (2024)	**Region with MIN(Average Detection Rate) from regional pivot**	Reveals where diagnosis systems are failing the most

Exploratory Data Analysis

The global time-series visualization (2000–2024) indicates a steady decline in average TB incidence per 100,000 population. The dashboard shows an overall incidence reduction of approximately 47.92% during this period.
Regional comparisons highlight significant variation:

- African (AFR) and South-East Asia (SEA) regions show the highest incidence levels.
- The European (EUR) region consistently maintains the lowest incidence levels.
- Western Pacific (WPR) and Eastern Mediterranean (EMR) demonstrate moderate but declining trends.

Comparative bar charts further indicate that regions with higher incidence often also display higher TB death rates. Detection rate analysis reveals variation across regions, suggesting differences in surveillance effectiveness.
These patterns indicate that while global progress is visible, regional disparities remain a key challenge.

Advanced Analysis

A comparative assessment between Detection Rate and TB Incidence was conducted using regional averages. Visual comparison suggests that regions with relatively higher detection rates tend to demonstrate more stable or gradually declining incidence trends. However, the relationship is not uniform across all regions, indicating that additional structural and socioeconomic factors may also influence TB burden.

The dashboard also highlights a detection gap of approximately 23.9% in the latest year, suggesting that a portion of estimated TB cases may remain undetected globally. While a negative association between detection performance and incidence levels is observable, this analysis remains descriptive in nature and does not establish causation.

Dashboard Design Explanation

The dashboard was developed in Google Sheets using pivot tables, calculated metrics,

slicers, and interactive filters.

Dashboard Objective

To provide a consolidated and interactive view of global TB burden trends, regional

comparisons, and detection performance indicators.

Key Dashboard Components

- Executive KPI summary (Incidence, Death Rate, Detection Gap, Regional Burden)
- Global time-series trend (2000–2024)
- Regional comparative bar charts
- Regional multi-line incidence trend visualization
- Top high-burden countries (2024)
- The dashboard enables filtering by WHO region and year, allowing dynamic exploration of TB trends and regional disparities.

Dashboard Screenshots

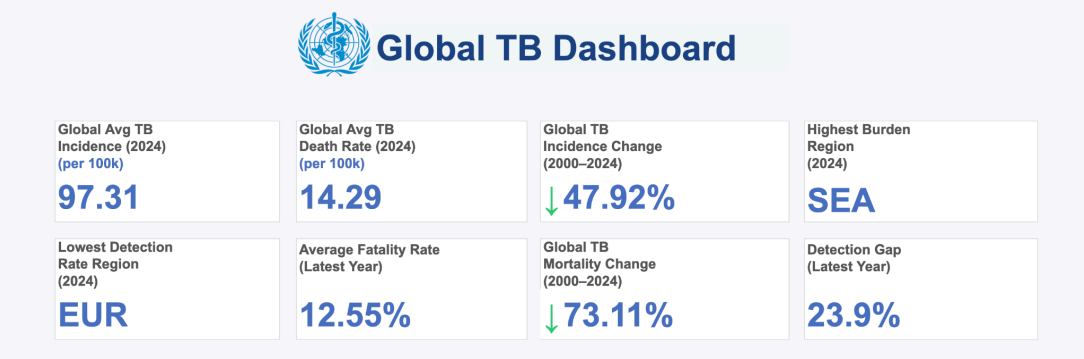

Figure 1: Executive Summary Dashboard – Global TB Performance Indicators (2024)

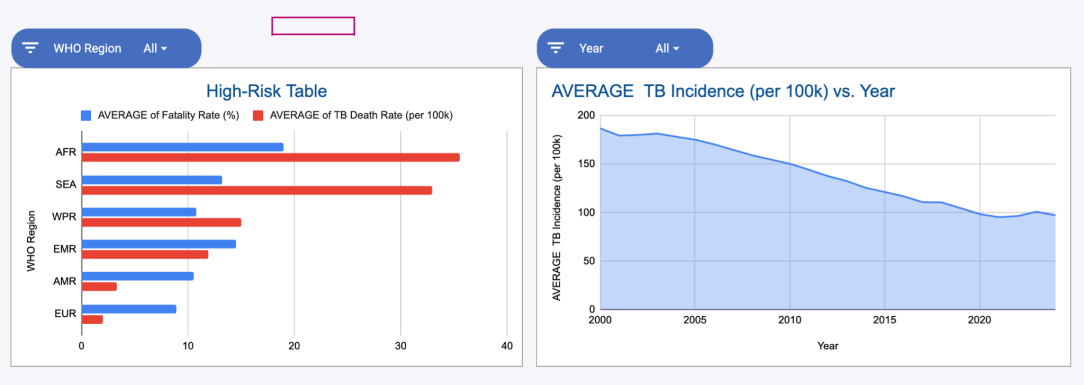

Figure 2: Regional Risk Profile and Global TB Incidence Trend Analysis (2000–2024)

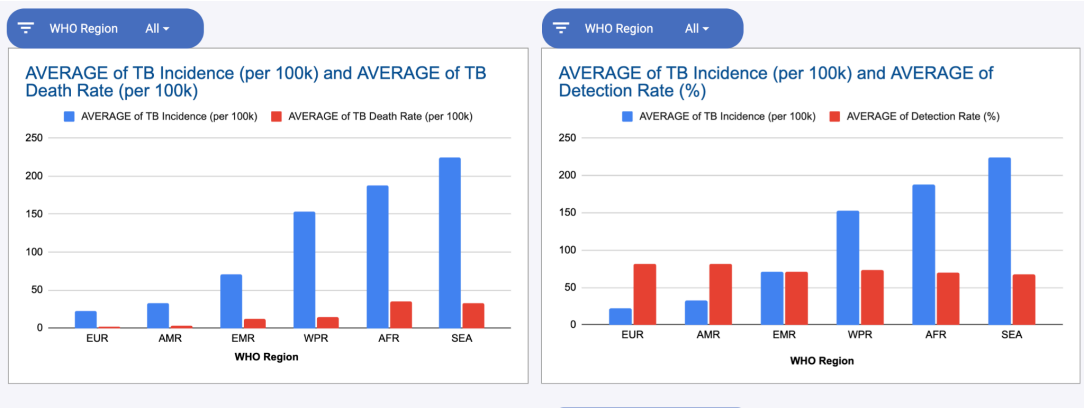

Figure 3: Regional Comparative Analysis – Incidence, Mortality, and Detection Performance

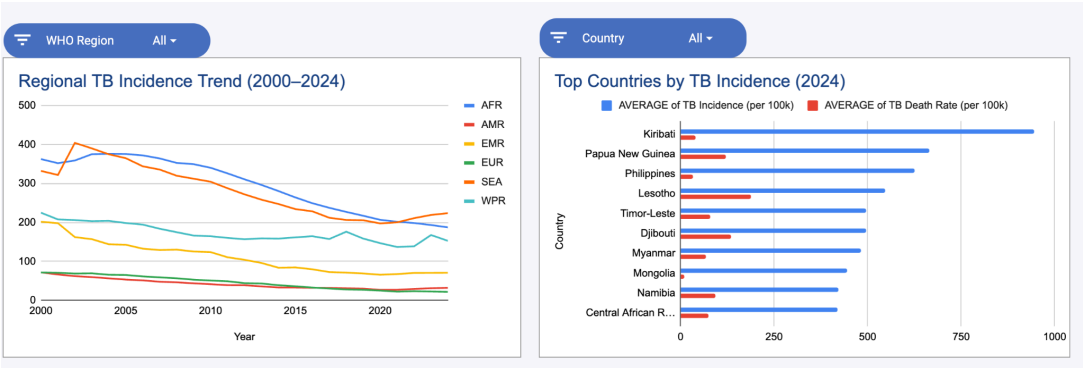

Figure 4: Regional TB Incidence Trends and High-Burden Country Analysis (2024)

Insights Summary

- Global TB incidence shows a long-term declining trend from 2000–2024.
- Detection rate improvements correlate with favorable incidence dynamics.
- Regional disparities remain significant despite global progress.
- High-burden regions demonstrate slower incidence reduction
- Detection efficiency emerges as a structural control variable.
- Incidence stabilization in some regions suggests plateau effects.
- Regional benchmarking reveals uneven policy implementation.
- Sustained detection improvement is essential for long-term elimination targets.

Recommendations

- Prioritize detection infrastructure investment in underperforming regions.
- Expand early screening and community-level diagnostic access.
- Implement region-level performance benchmarking frameworks.
- Strengthen integrated TB-HIV intervention strategies
- Link funding allocation to measurable detection improvements

Impact Estimation

If detection rates improve in underperforming regions, it is reasonable to expect gradual improvement in incidence reduction trends over time.

An increase of approximately 10% in detection performance could potentially contribute to earlier diagnosis, reduced transmission cycles, and improved treatment outcomes.

This estimation is directional in nature. A more precise impact projection would require statistical modeling and additional explanatory variables.

Limitations

- Aggregated national-level data limits granular inference.
- No socioeconomic or funding variables included.
- Potential reporting inconsistencies across regions.
- Correlation analysis does not establish causation.
- Limited project timeframe restricted the use of advanced statistical modeling techniques.

Future Scope

- Add funding & expenditure data
- Apply regression modeling
- Forecast incidence trends
- Country-level segmentation

Conclusion

The analysis demonstrates that detection efficiency plays a critical role in shaping global TB incidence dynamics. Although global progress is evident, regional disparities persist, requiring targeted policy reinforcement. Strengthening detection systems remains the most scalable and evidence-supported strategy for accelerating TB burden reduction.

Contribution Matrix

Members	Sourcing	Cleaning	KPI & Analysis	Dashboard	Report Writing	PPT	Overall Role
Phalak Sharma	-	-	-	-	✓	-	-
Atharva Sharma	-	✓	-	-	-	-	✓
Vipul Sharma	-	-	-	✓	-	-	-
Vikash Kumar	-	-	✓	-	-	-	-
Rahul Kumar	-	-	-	-	-	✓	-
Yash Yadav	✓	-	-	-	-	-	-