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1) Introduction

1.1 Statement of the Problem

Tuberculosis (TB) is one of the most dangerous disease in the world, especially in low- and middle-income nations. Even though it is preventable and curable it is still the most common infectious disease-related cause of death. Due to under reporting, social stigma, and insufficient healthcare systems, hundreds of thousands of new cases are reported every year, many of that stay undiagnosed or untreated.

There's have been multiple attempts at reducing the impact and spread of tuberculosis. Compared to other developed nations, certain countries, especially those in developing and underdeveloped regions, continue to have significantly greater mortality and incidence rates.

We can evaluate the rate of TB-related problems across various regions of the world and figure out how close we are to accomplishing TB elimination goals due to the availability of both recently updated and historical TB data (from 1990 to 2013). However, without useful visuals raw data alone can be difficult and challenging to understand.

Therefore, we need understandable, interactive, and user-friendly data visualizations in order to help policymakers, researchers, and the general public understanding TB trends, evaluate burdens across regions, and identify key areas for action.

1.2 Background

The bacterium Mycobacterium tuberculosis is the cause of the infectious disease tuberculosis (TB), which mainly affects the lungs. With serious health, financial, and societal impacts, it has been among one of the most deadly infectious diseases for many years. Millions of people around the world still get tuberculosis every year, despite the fact that it is preventable and curable. Many of these individuals lack access to appropriate diagnosis and treatment.

Global health organizations, particularly the World Health Organization (WHO), have made considerable efforts to monitor TB burden through the collection of annual data on incidence, prevalence, and mortality. Between 1990 and 2013, many countries achieved progress in reducing TB cases and deaths. However, Obstacles remain, with some regions still experiencing high rates of infection and mortality. In 2024, updated TB data became available, offering new insights into how countries are currently managing TB and whether global health goals are being met.

With the increasing importance of data-driven decision-making, there is a growing need for visual tools that simplify complex health data and make it accessible to a wide audience. Data visualization not only enhances understanding but also supports more targeted and effective public health interventions.

1.3 Objectives

The primary objective of this project is to create an interactive Power BI dashboard that displays global TB data from 1990-2013. This will allow users to explore TB data by key indicators including TB incidence, mortality, prevalence, and detection, across countries, regions, and years.

More specifically, the objectives are

•To develop a clean, user-friendly interface to explore TB data by year, region, and country;

•To visualize key TB metrics using dynamic visualizations including KPI cards, line charts, bar charts, and maps;

•To characterize TB burden trends over time and indicate progress made, and persistent barriers;

•To facilitate data-driven policy by providing more informalized TB data that can be better understood and acted upon.

1.4 Significance of the Study

This study is significant because it provides a visual tool that simplifies complex TB data and presents it in a way that is accessible to both technical and non-technical audiences because raw numbers and spreadsheets can be difficult to interpret, interactive dashboards allow users to see patterns, trends, and problem areas more clearly.

This study provided valuable and concise data from the World Health Organization (WHO) on TB between 1990 and 2013 via a clear interactive Power BI dashboard to allow users to see trends over time, compare regions, and/or countries and understand the burden of TB over time. The dashboard captured the key global indicators such as TB incidence, mortality, prevalence, etc. in visually understood formats to highlight the areas with a high-burden of illness and to demonstrate how global progress had changed over time.

This type of assessment would allow public health officials, researchers and students to explore and derive insights on TB data quickly which would lead them to make informed decisions. Furthermore, it emphasized the value of understanding data visualization in order to communicate complex health information in an informal and

engaging manner. The overall project highlighted how the power of visuals can ultimately help turn raw data into meaningful activities.

2) Methodology

This project followed a structured process that involved data preparation, transformation, visualization, and documentation to create an interactive dashboard for exploring global TB burden from 1990 to 2013. The following steps outline the methodology used:

2.1) Data Collection

The dataset used in this project was sourced from the World Health Organization (WHO), which includes country-level tuberculosis data between 1990 and 2013. The dataset contained multiple indicators such as TB incidence, mortality, prevalence, and case detection rates, organized by country and year.

2.2) Data Cleaning and Preparation

Data cleaning was performed using **Python (Jupyter Notebook)** with the panda's library. The following actions were taken:

- Irrelevant columns were removed.
- Check the data if it was a **wide format** (with years as columns) to convert to a **long format** (with year as a row entry) to make it suitable for Power BI but all the data was in long format and no further step was taken.
- Duplicates were dropped
- Columns were renamed for clarity (e.g., "Estimated number of incident cases (all forms)" → "Total New TB Cases").
- Missing values were handled by removing rows with null values in key indicators.
- Regions names were mapped from abbreviation to their full name for better understanding when applying filters
- Only relevant indicators were selected to focus on meaningful analysis (e.g., total new cases, deaths, incidence rate, detection rate).
- The new cleaned data was saved and used in Power BI for visualization

2.3) Data Visualization

The cleaned data was imported into **Power BI**, a powerful tool for creating interactive dashboards. The following types of visuals were created:

- **KPI cards** to display key metrics like total new TB cases, deaths, and people living with TB.
- **Line charts** to show trends over time from 1990 to 2013.
- **Stacked bar charts** to compare TB deaths by country.

- **Pie charts** to visualize the distribution of new TB cases by region.
- **Tables** to summarize the top 10 countries by TB prevalence, including related indicators.
- **Slicers** (filters) for Year, Region, and Country to allow users to explore the data dynamically.

2.4) Dashboard Design

Visual elements were organized into a clean, structured layout with clear titles and labels. A consistent color scheme was used to make the visuals easy to interpret. Text boxes were added to explain each chart or section and guide users through the dashboard.

2.5) Documentation

A final report was written to explain the purpose, process, and findings of the project. This includes an introduction, background, objectives, significance of the study, and methodology.

3) Dashboard Features and Visuals

The dashboard used for this project was built in Microsoft Power BI and was made to provide a clear and interactive view of the global tuberculosis (TB) burden between **1990 and 2013**. It focuses on making complex health data easier to understand by using visuals that are simple, and interactive. The dashboard includes different features and visuals having a specific purpose in helping users explore and analyze the data effectively.

3.1 Overview of KPIs

To give users a quick and simple idea of the global TB situation, the dashboard has three main performance indicators (KPIs):

- The total number of people living with TB
- The rate of new TB cases per 100,000 population
- The rate of TB deaths per 100,000 population

These KPI cards are placed at the top of the dashboard and update automatically when the user applies filters for year, region, or country. They help users immediately understand the level of TB burden in any selected context.

3.2 Line Chart - TB Incidence, prevalence and death Trends Over Time

This line charts are used to show how TB incidence (new cases per 100,000) and number of people living with TB change over time from 1990 to 2013. This visual helps us to see global and regional trends whether the number of cases has been increasing, decreasing, or remaining stable over time also it shows whether more people are continuing to live with the disease over time and shows if death by tuberculosis are increasing or are they decreasing. It provides background information for assessing the results of the prevention measures in that period of time and helps to evaluate the effectiveness of treatment efforts, health system capacity, and overall progress in reducing the chronic impact of TB across different regions.

3.3 Stacked Bar Chart – TB Deaths by Country

To compare the total number of TB-related deaths among different countries, a clustered bar chart was used. This visual is especially useful for identifying countries with a high mortality rate and highly effected by this disease. It has user-selected filters (such as region or year), allowing users to drill down into specific contexts and timeframes.

3.4 Pie Chart – New TB Cases by Region

The dashboard also includes a donut chart that displays the regional distribution of new TB cases for a selected year. Each slice of the donut represents a region's share of global TB incidence. This makes it easy to see which regions carry the largest proportion TB infected peoples, and how that distribution changes depending on the selected year.

3.5 Table – Top 10 Countries by TB Prevalence

A ranked table highlights the top 10 countries with the highest number of people living with TB in a given year. In addition to total prevalence, the table includes:

- The average rate of new TB cases per 100,000
- The average rate of TB deaths per 100,000
- The case detection rate (in percentage)

This table provides a more detailed, side-by-side comparison of high-burden countries across several important indicators. It helps users identify where the most severe and complex challenges exist.

4) Results and Findings

The interactive dashboard developed in this project provides insight into the global tuberculosis (TB) burden from 1990 to 2013. Through visual analysis of key

indicators such as incidence and prevalence, we can observe meaningful trends and the impact of global health efforts over time.

4.1) Trend in New TB Cases per 100,000 (Incidence Rate) by year and region

The data shows that from 1990 to the early 2000s, the incidence rate gradually increased, peaking at just over 150 cases per 100,000. This period reflects growing TB spread in regions like Africa and Europe, likely influenced by different factors.

However, beginning around 2005, the trend reversed significantly. The average number of new TB cases started to decline steadily, reaching below 120 per 100,000 by 2013. This drop suggests that international TB control programs, improved access to diagnostics and treatment, and greater global awareness may have contributed to reducing the number of new infections but around 2013 the Eastern Mediterranean had a spike of cases.

4.2) Trend in People Living with TB (Prevalence)

From 1990 to around 1999, the number of people affected by TB remained relatively stable, fluctuating between 14 to 15 million globally. However, from the early 2000s onward especially after 2005 there was a clear and consistent decline.

By 2013, the global number of people living with TB had dropped to just over 11 million, indicating that fewer individuals were remaining untreated or undiagnosed over time. This trend aligns with global efforts focused on expanding TB treatment coverage and improving healthcare infrastructure in heavily affected areas.

4.3) Trend in Total TB Deaths Over Time

The line chart shows Sum of Total TB Deaths by Year shows a fluctuating but overall declining trend in the global TB death toll. Between 1990 and the late 1990s, the number of TB deaths was around 1.5 to 1.6 million annually, with some years seeing having a slight increase. The peak was around 1999, after which a consistent and significant decline is observed. By 2013, the number of deaths had dropped to just above 1 million. This constant reduction shows progress in TB control efforts globally, likely influenced by improved diagnostics, better access to treatment, and public health interventions over the years. The other visualization used to show death over time was The stacked bar chart which shows the top 10 countries with the mortality rate therefore these countries should work more on treating TB patients and reducing there death rates.

4.4) Regional Distribution of New TB Cases

The pie chart Distribution of New TB Cases by Region provides insight into the regional burden of TB. South-East Asia accounts for the largest share of new TB cases, contributing approximately 37.37% (about 79.5 million cases). Africa follows with 24.05% (51.17 million cases), highlighting it as another high-burden region. The Western Pacific region contributes 22.79% (48.49 million cases), while the remaining regions Eastern Mediterranean, Europe, and the Americas—collectively account for less than 20% of the global cases.

This distribution emphasizes that TB remains a significant health challenge in developing regions, particularly in South-East Asia and Africa. It highlights the need for targeted interventions and resource allocation to these high burden areas to further reduce the incidence of the disease.

4.5) Overall view

These visuals clearly show a positive downward trend in TB incidence, Total TB deaths and prevalence between 2005 and 2013.

5) Future Predictions

Based on the data analyzed from 1990 to 2013, there is clear evidence of a global decline in both the number of people living with tuberculosis (TB) and the rate of new infections. If the progress made during that period continues at a similar pace, it is expected that TB incidence and prevalence will keep decreasing in the coming years. However, the future of TB control depends heavily on a number of critical factors.

5.1) Continued Progress Is Possible

If governments and global health organizations maintain strong TB control efforts such as early detection, consistent treatment programs, and public education it's likely that TB rates will continue to fall. Future advancement in medical technology including faster diagnostic tools and more effective treatment, could also speed up the reduction of TB worldwide.

5.2) Potential Challenges Ahead

Despite the progress, some countries and regions may continue to struggle due to poverty, weak healthcare infrastructure, and limited access to medical services. TB also remains closely linked to other health and social issues like malnutrition, HIV, and poor living conditions. Without countries investing to solve their problems and international support, these challenges could slow or even reverse some of the progress that has been made.

5.3) The Role of Innovation and Data

Looking ahead, the use of real-time data tracking, AI-driven diagnostics, and digital health tools could play a huge role in improving how TB is monitored and managed. Dashboards like the one created in this project show how powerful data visualization can be in helping decision-makers quickly spot patterns and act on them.

5.4) Final Outlook

If global momentum is sustained, it is realistic to predict that TB incidence could fall well below 100 cases per 100,000 people within the next decade in many countries. However, eliminating TB entirely will require not just medical solutions, but also addressing the underlying social and economic conditions that allow the disease to increase and exist.

6) Recommendation

To continue reducing the global burden of tuberculosis, it is important that countries maintain strong public health programs focused on early detection, proper treatment, and community education. Special attention should be given to countries with higher TB rates, so that resources and support can be directed where they are needed most. Making TB data easier to understand through tools like dashboards can also help decision-makers take faster and more effective action.

7) Conclusion

This project explores the global burden of tuberculosis (TB) from 1990 to 2013 using interactive data visualization. By transforming complex health data into an accessible and user-friendly Power BI dashboard, it makes it possible to identify important trends and patterns in TB incidence, mortality, and prevalence across different countries and regions.

The visual analysis showed clear signs of progress over years, with a steady decline in both new TB cases and the total number of people living with the disease. These positive trends reflect the impact of global public health efforts, including improved diagnosis, treatment, and education. However, the data also revealed that progress has not been equal across all regions, and that high-burden countries still face significant challenges.

Overall, the dashboard provides valuable insights that can help health professionals, researchers, and policymakers make more informed decisions. It demonstrates how powerful data visualization can be in communicating public health information and guiding future action.

While this project focused on historical data, it also highlights the importance of continuously monitoring TB trends. With the right tools and sustained global effort, the goal of reducing and eventually eliminating TB as a major public health threat is achievable.