DATA VISUALIZATION ISM 6419

Global Healthcare Spending and Life Expectancy: An Efficiency Perspective

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1.Introduction:
This report aims to understand the relationship between a country's healthcare investment and its population's life expectancy. which is vital for public policy and resource optimization. This report explores how effectively different nations convert healthcare spending into health outcomes by analyzing global data from 2000 to 2020. It uses interactive Power BI dashboards to visualize trends, disparities, and efficiency gaps across countries and regions.

2.Research Questions:

- **What is the relationship between healthcare spending and life expectancy across countries?**

  By examining both health expenditure (as a percentage of GDP and in absolute terms) and life expectancy, this question explores whether higher spending correlates with better health outcomes. It also helps identify countries that achieve high life expectancy despite limited spending, revealing potential efficiencies in their health systems.

- **Which countries achieve the highest life expectancy relative to their healthcare spending?**

  This question aims to identify the most efficient countries — those that deliver the best health outcomes for the least investment. It highlights disparities in healthcare efficiency and uncovers potential best practices from high-performing nations.

- **How do life expectancy and HALE (Healthy Life Expectancy) compare across regions and countries?**

  This comparison sheds light on not just how long people live, but how many of those years are spent in good health. It allows us to assess quality vs. quantity of life and determine which regions may face greater burdens of chronic disease or disability.

- **How has global life expectancy evolved from 2000 to 2020, and where are the disparities?**

  Using a time-series analysis, this question tracks global progress in life expectancy over two decades and highlights regions or countries that have lagged behind. It provides insight into both improvements and inequities in global health.

3. Methodology

Data Sources:
1. World Bank – Health Expenditure (% of GDP)

Source:https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS
Description: This dataset provides annual healthcare expenditure as a percentage of each country's GDP. It serves as a standardized indicator to compare relative investment in healthcare across economies. This percentage was later combined with GDP values to calculate actual healthcare spending in USD.

2. WHO – Life Expectancy and HALE Datasets

Source: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/gho-ghe-hale-healthy-life-expectancy-at-birth
Description: These datasets contain global records of life expectancy and Healthy Life Expectancy (HALE), disaggregated by country, year, and sex. Life Expectancy reflects average lifespan, while HALE adjusts for years lived in less-than-full health, offering a quality-adjusted measure of longevity.

3. Our World in Data – Country-Level GDP

Source:https://ourworldindata.org/grapher/gdp-worldbank?time=2023
Description: This dataset provides GDP (in current USD) for all countries from 2000 to 2023. It was used to convert percentage-based health expenditure into actual amounts (USD) to allow cross-country comparison of real healthcare investment.

Data Cleaning & Processing.
The original datasets contained year-wise values spread across multiple columns, which were unpivoted using Python (Pandas) to convert them into a long format. This restructuring placed all year columns into a single column, allowing for easier time-series analysis in Power BI.

Unnecessary columns such as metadata, redundant codes, and notes were removed to streamline the datasets for analysis. The cleaning process also involved standardizing country names and aligning formats across the three primary datasets (life expectancy, HALE, and health expenditure).

To ensure analytical accuracy and completeness, countries with missing or significantly incomplete data across the required years (2000–2020) were excluded from the final model. This step helped prevent skewed insights due to data gaps or inconsistencies.
Python File:

DV_Project.ipynb

4.Visual Analysis of Insights

To address the research questions, multiple interactive visualizations were created in Power BI, drawing from the cleaned datasets. These visuals offer both global and country-level perspectives on health spending, life expectancy, and efficiency.

1. Global Life Expectancy Trend (Line Chart)
A line chart displays the global average life expectancy from 2000 to 2020. The trend indicates steady improvement, particularly in low and middle-income regions. A slight dip around 2020 and after reflects the early impact of the COVID-19 pandemic.

Insight: Global life expectancy has been rising, but disparities persist, especially between high-income and developing nations.
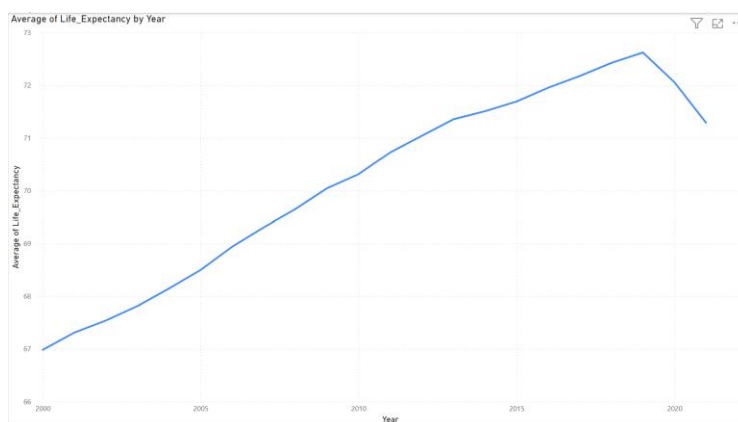
2. Average Life Expectancy by Country (Choropleth Map)
A filled map visualizes average life expectancy geographically. Countries in Western Europe and East Asia show the highest longevity, while sub-Saharan Africa and some conflict-affected regions show significantly lower values.
**Insight:** There are clear geographic clusters where countries either outperform or underperform in health outcomes, highlighting global inequality.
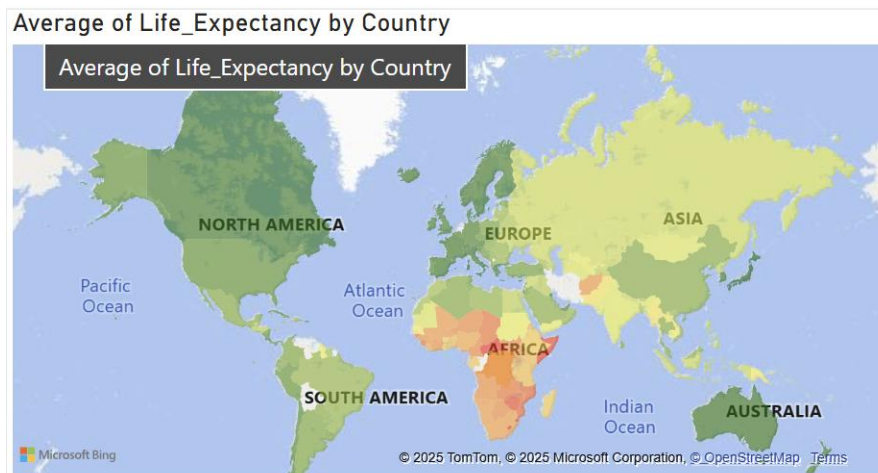
3. Top 10 Countries by Life Expectancy (Bar Chart)

This bar chart ranks countries based on their average life expectancy. Japan, Singapore, and Switzerland lead consistently across years.

Insight: High-performing nations often combine strong public health systems with moderate, efficient spending.
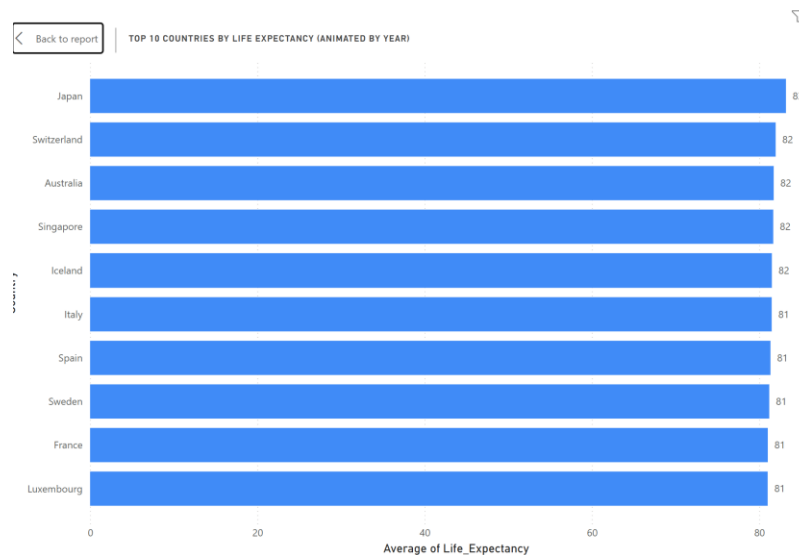
4. Health Spending vs Life Expectancy (Scatter Plot with Regression Line)

A scatter plot with a regression line visualizes the relationship between actual health spending (in trillions USD) and average life expectancy. Countries above the trend line (like Japan) achieve higher life expectancy than expected for their spending. Countries below it (like the U.S.) spend more but achieve lower-than-expected outcomes.

Insight: More spending doesn't always equal better health outcomes. Efficiency varies widely.
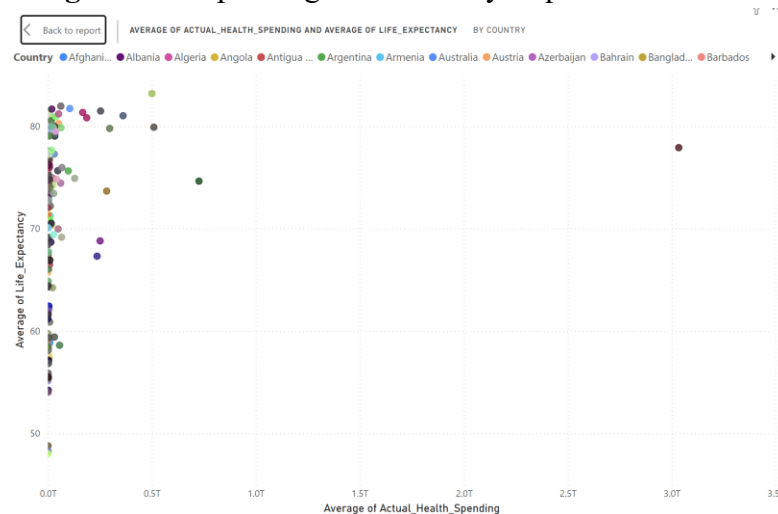
5. HALE vs Life Expectancy by Region (Clustered Bar Chart)

This chart compares average HALE (Healthy Life Expectancy) and total life expectancy across regions. A smaller gap indicates a healthier lifespan.

Insight: Some countries achieve long lives, but not necessarily healthy ones. The HALE gap highlights the quality-of-life factor.
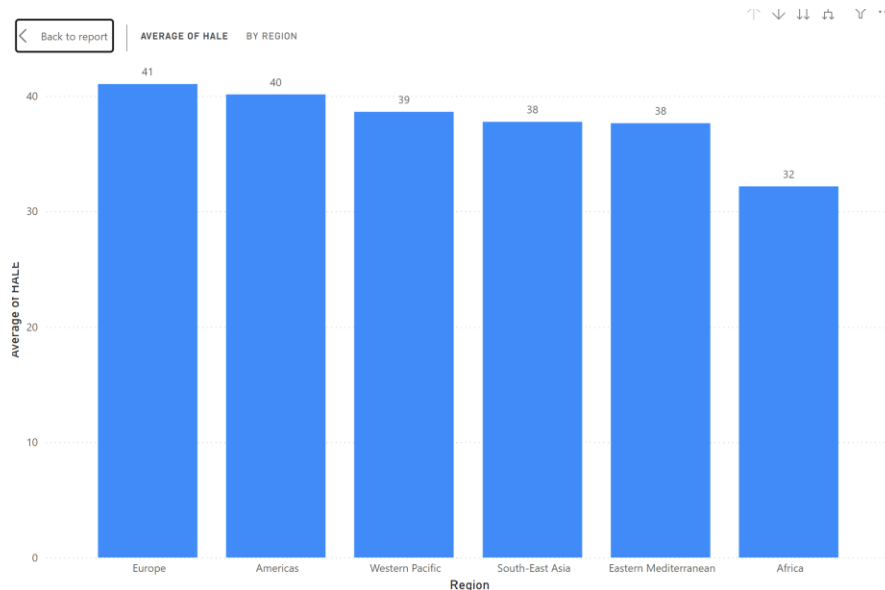
6. Healthcare Spending Drilldown by Region and Country

An interactive bar chart allows users to drill from regions into individual countries to explore spending patterns. It supports region-wise benchmarking.

Insight: Some regions with lower spending (e.g., parts of Asia) show relatively good health outcomes, while others with higher spending show inefficiencies.
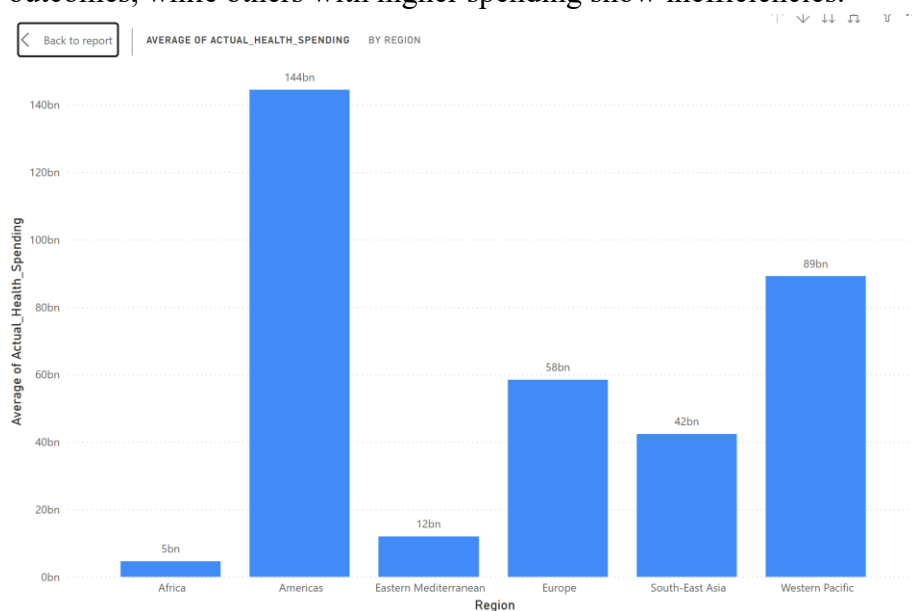
7. Animated Bar Chart Race – Health Spending Over Time
An animated chart displays how health spending evolved across countries from 2000 to 2020. It helps visualize the dynamic shifts in global health investment leadership.
Insight: The U.S. consistently leads in spending, but life expectancy does not match this investment. Meanwhile, several emerging economies steadily increased health investments.
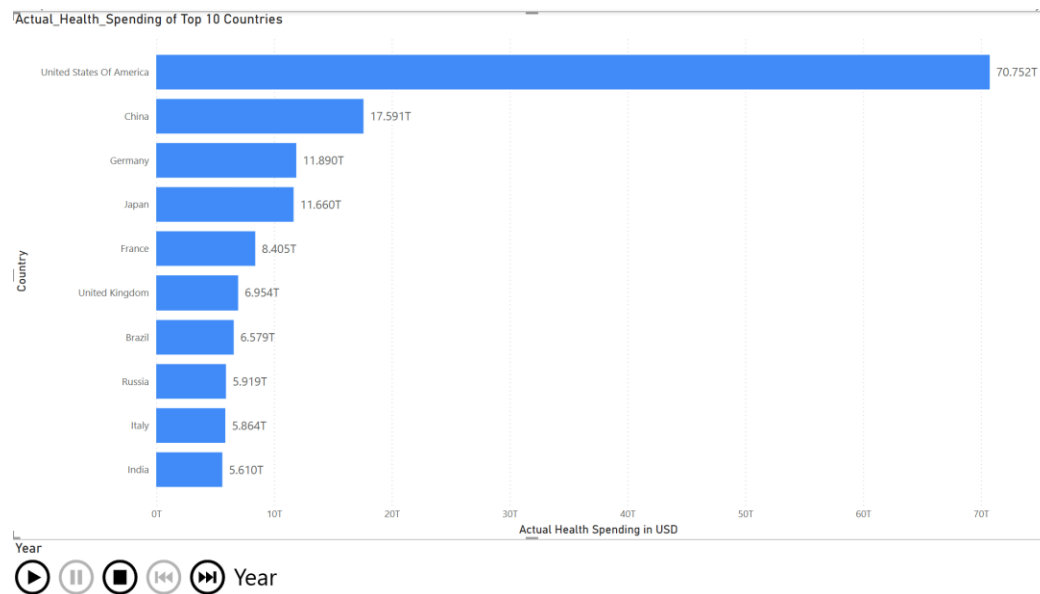
5. Key Findings

- Life expectancy has steadily improved globally, particularly in South Asia, Latin America, and some parts of Africa. However, regional disparities persist, with some countries still lagging well below the global average.
- Healthcare spending does not guarantee better outcomes. The United States spends the most in absolute terms yet does not appear in the top 10 for life expectancy. In contrast, countries like Japan, Singapore, and Switzerland achieve high longevity with comparatively lower spending.
- High-efficiency countries emerge as global models. Several nations demonstrate high life expectancy despite modest investment. These outliers highlight that well-structured health systems and preventive care can produce excellent results even with limited resources.
- The gap between Life Expectancy and HALE varies widely. In some regions, people live long lives but with more years spent in poor health. A smaller HALE gap indicates not only longer lives but healthier ones — an important distinction for public health planning.
- Geographical patterns are evident. Wealthier regions generally report higher health outcomes, but some middle-income countries are closing the gap. Heat maps and scatter plots reveal these clusters, highlighting both progress and inequality.

- Trendlines and regression analyses uncover inefficiencies. The regression line in the spending vs. life expectancy chart clearly shows countries that underperform despite high investment, pointing to potential inefficiencies in healthcare delivery.

6. Recommendations and Implementation

- **Promote efficient healthcare models:** Countries that achieve strong outcomes with lower health spending — such as Japan, Singapore, and Australia— should be studied further for policy transfer. Investing in preventive care, primary services, and universal coverage may replicate these successes in lower-performing nations.

- **Shift focuses from spending volume to outcome quality:** Policymakers should prioritize improving healthcare delivery efficiency, rather than simply increasing budgets. Emphasizing access, equity, and quality of care can improve outcomes without major cost increases.

- **Integrate HALE in national health strategies:** Governments should not only aim to increase life expectancy but also focus on quality of life. Investments in mental health, disability services, and healthy aging programs can reduce the years lived in poor health.

- **Use data to target regional disparities:** Countries with diverse populations or large rural areas can use dashboards like this one to identify regions that need targeted interventions, especially where both spending and outcomes lag behind.

7. Conclusion

This report highlights the complex and often non-linear relationship between healthcare spending and life expectancy. While wealthier Regions tend to live longer, many outliers demonstrate that efficiency matters more than budget size. Countries that prioritize preventive care and equitable access consistently outperform high spending yet inefficient systems.

The analysis shows that global life expectancy has increased overall, but disparities remain — both in terms of the years lived and the quality of those years (as seen in HALE data). Health policies should therefore aim for healthy, not just long, lives.

Power BI proved effective for transforming raw global health data into actionable insights. Through visual storytelling and interactive analysis, this project provides a strong foundation for deeper exploration into global health equity and efficiency.

8. Future Extension and Additional Research Questions

To further build on this analysis, future studies could explore:

- **What role does income inequality (e.g., Gini coefficient) play in health outcomes?**
  Adding inequality data could explain why some wealthy countries underperform in life expectancy.

- **How does education level influence health outcomes over time?**
  Linking life expectancy to literacy and educational access would help understand long-term health determinants.

- **What were the short- and long-term effects of the COVID-19 pandemic on HALE and life expectancy?**
  Including 2020–2024 data could reveal how resilient different health systems were during global crises.

- **How do countries allocate healthcare funds (preventive vs. curative)?**
  A deeper look into healthcare budgeting may explain why similar spending levels yield different outcomes.

- **Does public vs. private healthcare investment impact efficiency?**
  Future analysis could compare nations with largely public systems to those with privatized healthcare.