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BSc in Applied Data Science Communication

Advanced SQL and cloud databases - Assignment

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“Mapping the Path to Safer Motherhood: A Data Analytics Report on SDG 3 Health Indicators”

Content

1. Introduction

Sustainable Development Goal 3 (SDG 3), which is Good Health and Well-Being, prioritizes the well-being of all and at all ages, and guarantees living healthy lifestyles. Maternal and reproductive health indicators are some of its priorities, which are some of the core health indicators that can be used to measure the quality of healthcare systems, accessibility and equity of a healthcare system globally. This paper concentrates on three SDG 3 indicators that are critical which include Maternal Mortality Ratio (3.1.1), Skilled Birth Attendance (3.1.2), and Family Planning Coverage (3.7.1). The combination of these measures provides an overall picture of the outcomes in reproductive health and the focus on the areas where specific intervention is required.

Maternal mortality is one of the worst measures of inequality in world health. Although it has been observed that some success has been achieved over the last decades, a number of countries, most especially the low- and middle-income nations, continue to record unacceptable maternal mortality rates. Two of the biggest determinants are Skilled Birth Attendance and Family Planning that are strongly associated with maternal outcome facilitating not only survival but also long-term well-being and empowerment of women. These indicators are interrelated, and through them, a comprehensive analysis of maternal health systems, availability of the services, and social challenges can be achieved.

The datasets used in this project are the ones accessed in the World Health Organization (WHO) Global Health Observatory (GHO) and they comprise over 190 countries over various years. All data was cleaned and standardized before being stored in a structured SQL database to allow a wide-ranging analysis that would be modeled and visualized on Power BI. The dashboard that will be developed in the work is supposed to offer an interactive and a comparative interpretation of the global reproductive health dynamics, expose the geographical difference, and find the relationship between the three indicators chosen in this study.

In general, this report is a systematic study of SDG 3 health indicators based on the data processed in a mixture of SQL and power BI visualization. The project will also seek to provide actionable insights on policymakers, healthcare planners, and all stakeholders interested in improving maternal and reproductive health outcomes globally by combining global health data, trend analysis, and indicator relationships.

2. Data Set Description

This paper applies three important datasets of health in the world, which were obtained at the World Health Organization (WHO) Global Health Observatory (GHO), which is a highly authoritative site that gathers internationally comparable health indicators. The GHO includes country-aggregated, regularly updated, and standardized annual data, which is a reliable source of Sustainable Development Goal (SDG) monitoring and cross-country comparisons. Because SDG 3 focuses on the need to secure healthy lives and the well-being of people, the indicators concerning maternal health and reproductive care are the key to comprehending how the world advances and what countries need specific intervention.

The assessment is based on three key indicators, which include Maternal Mortality Ratio (SDG 3.1.1), Skilled Birth Attendance (SDG 3.1.2), and Family Planning Coverage (SDG 3.7.1). The collection of these indicators provides the full picture of maternal health outcomes, the readiness of the healthcare system, and the access to the necessary reproductive services by women.

>Maternal Mortality (Indicator 3.1.1) is an indicator that calculates the maternal deaths per 100,000 live births. This data can also have more fields like upper and lower uncertainty limits, which indicate differences in the quality of reporting among the countries. It is a serious indicator that is globally applied to measure the risks of maternal health and the success of healthcare interventions.

>Skilled Birth Attendance (Indicator 3.1.2) is the percentage of births whose attending health personnel (doctors, nurses, or midwives) is trained health personnel. It is a direct indicator of accessibility to healthcare and the capacity to deliver healthcare and is closely related to fewer maternal complications and deaths.

>The proportion of women aged 15-49 years using modern contraceptive methods (Family Planning Coverage (Indicator 3.7.1)) shows how many women are utilizing modern birth control techniques. This variable aids in determining the reproductive rights, women empowerment, and effectiveness of the health system in delivery of necessary family planning services.

Although the three datasets are different variables of maternal and reproductive health, they are organized in a similar way which makes integration and analysis a lot easier. All of the datasets have the following common fields:

>Country Name: Internationalized country names.

>ISO Code: Country specific ISO code, which ensures proper merging.

>Year / Time_Detail: The year of reporting of the observation.

>Value: Indicator value measured.

>Goal identifier: Goal identifier of SDG indicator.

>Name of Indicator: Full descriptive name of the indicator.

This uniformity facilitated efficient data cleaning and modeling and at the same time allowed direct comparisons between cross indicators at Power BI. Together, the datasets constitute a strong basis to assess the progress on global SDG 3, detect the disparities, and provide recommendations based on data.

3. Methodology

SQL Cleaning Procedure and Database Design

All raw datasets were first imported into a SQL database to guarantee high-quality input for dashboarding. Prior to being imported into Power BI, SQL was utilized for cleaning, transformation, and standardization.

Structure of the Database

There were three primary tables made:
>Maternal Death
>Expert Birth Attendance
>Planning for the Family

Step 1- Remove rows with missing country names

```
--Remove rows with missing country names
DELETE FROM [Goal 3.1.1]
WHERE GeoAreaName IS NULL OR GeoAreaName = '';

DELETE FROM [Goal 3.1.2]
WHERE GeoAreaName IS NULL OR GeoAreaName = '';

DELETE FROM [Goal 3.7.1]
WHERE GeoAreaName IS NULL OR GeoAreaName = '';
```

By running DELETE statements in each of the three raw indicator tables (Goal 3.1.1, Goal 3.1.2, and Goal 3.7.1), this script cleans the data initially. It targets records with an empty string ('') or a geographical identifier (GeoAreaName) that is explicitly missing (NULL). Because data without a country cannot be used for national comparisons, aggregation, or geographic mapping in Power BI, removing these records is crucial.

Step 2 - Convert text to numbers where needed

```sql
--Convert text to numbers where needed

UPDATE [Goal 3.1.1]
SET Value = TRY_CAST(Value AS FLOAT);

UPDATE [Goal 3.1.2]
SET Value = TRY_CAST(Value AS FLOAT);

UPDATE [Goal 3.7.1]
SET Value = TRY_CAST(Value AS FLOAT);
```

This SQL code uses the TRY_CAST function with FLOAT as the target data type to update the Value columns of three goal-related tables (Goal_3.1.1, Goal_3.1.2, and Goal_3.7.1) from text to numeric format. This method is perfect for cleaning data when the Value column may contain mixed text and numeric entries that need to be standardized for mathematical operations or analysis. The TRY_CAST function safely tries to convert each value to a floating-point number, returning NULL for any values that cannot be converted rather than generating an error.

Step 3 - Standardize column names

```sql
--Standardize Column Names

EXEC sp_rename '[Goal 3.1.1].GeoAreaName', 'Country_Name', 'COLUMN';
EXEC sp_rename '[Goal 3.1.1].TimePeriod_Year', 'Year', 'COLUMN';

EXEC sp_rename '[Goal 3.1.2].GeoAreaName', 'Country_Name', 'COLUMN';

EXEC sp_rename '[Goal 3.7.1].GeoAreaName', 'Country_Name', 'COLUMN';
```

The given SQL code snippet uses a number of EXEC sp_rename commands to standardize column names across various database tables. In the tables indicated by [Goal 3.1.1], [Goal 3.1.2], and [Goal 3.7.1], the script specifically renames the GeoAreaName column to Country_Name. It also changes the [Goal 3.1.1] table's TimePeriod_Year column to Year. Each command ends with the 'COLUMN' argument, which indicates that the object type being renamed is a column.

Step 4 - Check for duplicates

```sql
--Check for duplicates
SELECT Country_Name, TimePeriod_Year, COUNT(*) AS Count
FROM [Goal 3.1.1]
GROUP BY Country_Name, TimePeriod_Year
HAVING COUNT(*) > 1;

SELECT Country_Name, Year, COUNT(*) AS Count
FROM [Goal 3.1.2]
GROUP BY Country_Name, Year
HAVING COUNT(*) > 1;

SELECT Country_Name, Year, COUNT(*) AS Count
FROM [Goal 3.7.1]
GROUP BY Country_Name, Year
HAVING COUNT(*) > 1;
```

The given SQL code snippet is intended to search for duplicate rows in three distinct tables: [Goal 3.1.1], [Goal 3.1.2], and [Goal 3.7.1]. Every query looks for rows that have the same combination of Year and Country Name (or TimePeriod_Year in the first query, indicating the original column name). This is accomplished by filtering the grouped results using the HAVING COUNT(*) > 1 clause after applying the GROUP BY clause to the country and year columns. This filter effectively highlights duplicate combinations and the number of times each combination appears (aliased as Count) by ensuring that the query only returns groups where the count of rows is greater than one.

Step 5 - Countries dimension table

```sql
--Countries Dimension Table
CREATE TABLE Countries (
    CountryID INT IDENTITY(1,1) PRIMARY KEY,
    Country_Name NVARCHAR(200) UNIQUE
);

INSERT INTO Countries (Country_Name)
SELECT DISTINCT Country_Name FROM [Goal 3.1.1]
WHERE Country_Name NOT IN (SELECT Country_Name FROM Countries);

select* from Countries
```

The provided SQL code snippet is designed to implement a dimension table for countries, a common practice in data warehousing. First, a new table called Countries is defined using a CREATE TABLE statement. It has two columns: Country_Name, which must be unique and contains the name of the country, and CountryID, which is an automatically incrementing primary key. This new Countries table is filled using an INSERT INTO statement after the table is created. In order to prevent duplicates from being added in later runs, it chooses the unique country names from the [Goal 3.1.1] table and inserts them only if they do not already exist in the Countries table. Lastly, the newly created and populated dimension table's contents are displayed using a select * from the country's command.

Step 6 - Add foreign keys to each fact table

```
--Add Foreign Keys to Each Fact Table
ALTER TABLE [Goal 3.1.1] ADD CountryID INT;

UPDATE g
SET g.CountryID = c.CountryID
FROM [Goal 3.1.1] g
JOIN Countries c ON g.Country_Name = c.Country_Name;
```

The provided SQL code snippet is a crucial step in transforming a transactional table into a fact table for a data warehouse design using a Star Schema model.
First, a new integer column called CountryID is added to the fact table using the ALTER TABLE command [Goal 3.1.1]. The purpose of this new column is to act as a foreign key that connects the dimension table and the fact table. The previously created Countries dimension table (aliased as c) and the fact table ([Goal 3.1.1] aliased as g) are then joined by an UPDATE statement based on matching Country_Name values. Lastly, it replaces the string-based country name with an integer ID to enhance query performance and data storage efficiency by populating the new CountryID column in the fact table (g.CountryID) with the corresponding surrogate key value from the dimension table (c.CountryID).

Step 7 - Final verification

```sql
--Final Verification
SELECT * FROM [Goal 3.1.1] WHERE CountryID IS NULL;

SELECT MIN(Year), MAX(Year) FROM [Goal 3.1.1];

SELECT TOP 20 * FROM [Goal 3.1.1];
SELECT TOP 20 * FROM [Goal 3.1.2];
SELECT TOP 20 * FROM [Goal 3.7.1];
```

The provided SQL code represents a final verification step after a data transformation process, likely preparing data for a data warehouse.
The transformed fact tables are subjected to multiple checks in this section ([Goal 3.1.1], [Goal 3.1.2], and [Goal 3.7.1]). In order to ensure that every record has a valid country identifier, the first command selects all rows from [Goal 3.1.1] where the CountryID is NULL in order to check for missing foreign key values. By providing the lowest and maximum Year found in the [Goal 3.1.1] table, the second query verifies the temporal range of the data. In order to visually verify the structure and contents of the transformed data, the code then runs three distinct SELECT TOP 20 * statements to sample the first 20 records from each of the three fact tables.

4. Power BI Modeling

This analytical dashboard's core component is the Power BI modelling stage, which makes sure that the three health-related datasets—Maternal Mortality (3.1.1), Skilled Birth Attendance (3.1.2), and Family Planning Coverage (3.7.1)—are integrated in an organised and effective way. Accurate DAX calculations, cross-indicator comparisons, drill-through functionality, and performance optimisation all required proper modelling. The cleaned SQL outputs were directly connected to Power BI, guaranteeing that the underlying data was standardised, validated, and consistent before being loaded into the model.

4.1 Power Query Transformations and Data Import

From the SQL Server environment, all three of the cleaned datasets were imported into Power BI. To maximise memory usage, superfluous columns like metadata, notes, or redundant identifiers were eliminated during the Power Query stage. Additionally, data types were standardised, converting country names to text with uniform formatting and casing, indicator values to numeric decimals, and years to whole numbers. To maintain consistency, small changes were made, like renaming columns, eliminating null rows, and making sure that ISO codes matched between tables. These initial changes made sure the datasets were prepared for modelling without adding uncertainty.

4.2 Creating a Calendar Table

Since all the indicators were time-based and required trend analyses, one dedicated Calendar Table (Date/Year dimension) was created. This table contains continuous Year values covering the full timeline from the earliest to the latest year present in the datasets. The Calendar table works as a shared dimension, linking all three health indicator tables together. Thus, creating one single authoritative time dimension allowed synchronized filtering across the dashboard and enabled consistent year-wise comparisons of Maternal Mortality, Skilled Birth Attendance, and Family Planning Coverage.

4.3 Data Model Structure

A clean star-schema model was set up to improve performance and clarity. The Calendar table served as the central dimension, while the three datasets—Maternal Mortality, Skilled Birth Attendance, and Family Planning—acted as separate fact tables. The relationships were established as follows:

Calendar[Year] → Maternal_Mortality[Year]

Calendar[Year] → Skilled_Birth_Attendance[Year]

Calendar[Year] → Family_Planning[Year]

These one-to-many relationships enabled cross-filtering by time and prevented circular dependencies. No direct relationships were made between the three indicator tables to avoid confusion and to keep a clean, modular structure.

4.4 Dax measures

```
Latest Maternal Mortality ratio =
CALCULATE(
    AVERAGE('Goal 3 1 1_Maternal Mortality'[Value]),
    'Goal 3 1 1_Maternal Mortality'[Year] = MAX('Goal 3 1 1_Maternal Mortality'[Year])
)
```

This measure determines the average value of the maternal mortality records that are only for the latest year available in the data.

```
Latest_Skilled Birth Attendance =
CALCULATE(
    AVERAGE('Goal 3 1 2_Skilled Birth Attendance'[Value]),
    'Goal 3 1 2_Skilled Birth Attendance'[Year] = MAX('Goal 3 1 2_Skilled Birth Attendance'[Year])
)
```

This measure determines the average value of the skilled birth attendance (SBA) records that are only for the latest year available in the data.

```
Latest_Family Planning =
CALCULATE(
    AVERAGE('Goal 3 7 1_Family Planning'[Value]),
    'Goal 3 7 1_Family Planning'[Year] = MAX('Goal 3 7 1_Family Planning'[Year])
)
```

This measure determines the average value of the family planning records that are only for the latest year available in the data.

```
1  Country_Highest_Maternal_Mortality =
2  VAR MaxValue =
3      MAX('Goal 3 1 1_Maternal Mortality'[Value])
4  RETURN
5  CALCULATE(
6      SELECTEDVALUE('Goal 3 1 1_Maternal Mortality'[Country_Name]),
7      'Goal 3 1 1_Maternal Mortality'[Value] = MaxValue
8  )
9
```

This measure locates the highest value of maternal mortality in the data and then finds the country related to that highest value.

```
Country_Lowest_Maternal_Mortality =
VAR MinValue =
    MIN('Goal 3 1 1_Maternal Mortality'[Value])
RETURN
CALCULATE(
    SELECTEDVALUE('Goal 3 1 1_Maternal Mortality'[Country_Name]),
    'Goal 3 1 1_Maternal Mortality'[Value] = MinValue
)
```

This measure locates the lowest value of maternal mortality in the data and then finds the country related to that lowest value.

```
Max_Maternal_Mortality =
MAX('Goal 3 1 1_Maternal Mortality'[Value])
```

This straightforward measure returns the absolute maximum value recorded for maternal mortality across the whole dataset.

```
Min_Maternal_Mortality =
MIN('Goal 3 1 1_Maternal Mortality'[Value])
```

This straightforward measure returns the absolute minimum value recorded for maternal mortality across the whole dataset.

```
Countries_Below_50_SBA =
CALCULATE(
    DISTINCTCOUNT('Goal 3 1 2_Skilled Birth Attendance'[Country_Name]),
    FILTER(
        'Goal 3 1 2_Skilled Birth Attendance',
        [Avg_Skilled_Birth_Attendance] < 50
    )
)
```

Counting the distinct Country_Names is the purpose of this metric, where the pre-calculated measure [Avg_Skilled_Birth_Attendance] is less than 50.

```
Countries_Above_90_SBA =
CALCULATE(
    DISTINCTCOUNT('Goal 3 1 2_Skilled Birth Attendance'[Country_Name]),
    FILTER(
        'Goal 3 1 2_Skilled Birth Attendance',
        [Avg_Skilled_Birth_Attendance] >= 90
    )
)
```

There is a complete count of distinct country names in this metric and these countries are conditionally selected if the value of the pre-calculated measure [Avg_Skilled_Birth_Attendance] is at least 90.

```
Countries_Above_80_FP =
CALCULATE(
    DISTINCTCOUNT('Goal 3 7 1_Family Planning'[Country_Name]),
    FILTER(
        VALUES('Goal 3 7 1_Family Planning'[Country_Name]),
        [Avg_Family_Planning] >= 80
    )
)
```

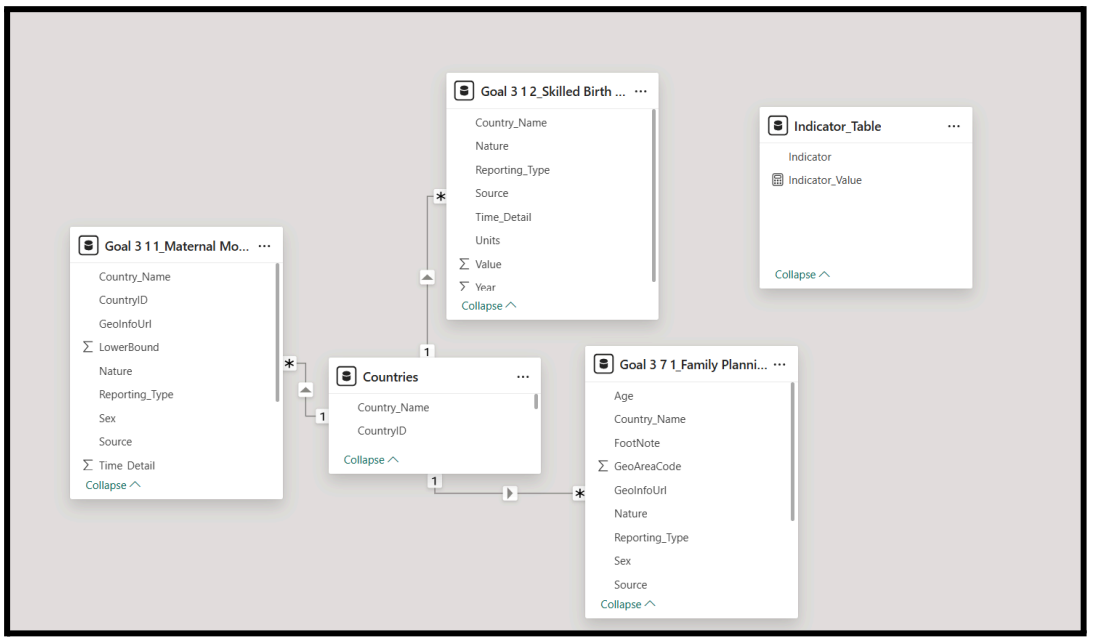
This metric provides a complete count of distinct country names where the value of the pre-calculated measure [Avg_Family_Planning] is 80 or more.

```
Countries_Below_30_FP =
CALCULATE(
    DISTINCTCOUNT('Goal 3 7 1_Family Planning'[Country_Name]),
    FILTER(
        VALUES('Goal 3 7 1_Family Planning'[Country_Name]),
        [Avg_Family_Planning] < 30
    )
)
```

The measure identifies the number of countries based on the distinct count of the Family Planning table where the condition [Avg_Family_Planning]<30 is satisfied in the measure.

```
Year_Highest_FP_Adoption =
VAR MaxFP =
    CALCULATE(
        MAXX(
            VALUES('Goal 3 7 1_Family Planning'[Year]),
            [Avg_Family_Planning]
        )
    )
RETURN
CALCULATE(
    MAX('Goal 3 7 1_Family Planning'[Year]),
    FILTER(
        ALL('Goal 3 7 1_Family Planning'[Year]),
        [Avg_Family_Planning] = MaxFP
    )
)
```

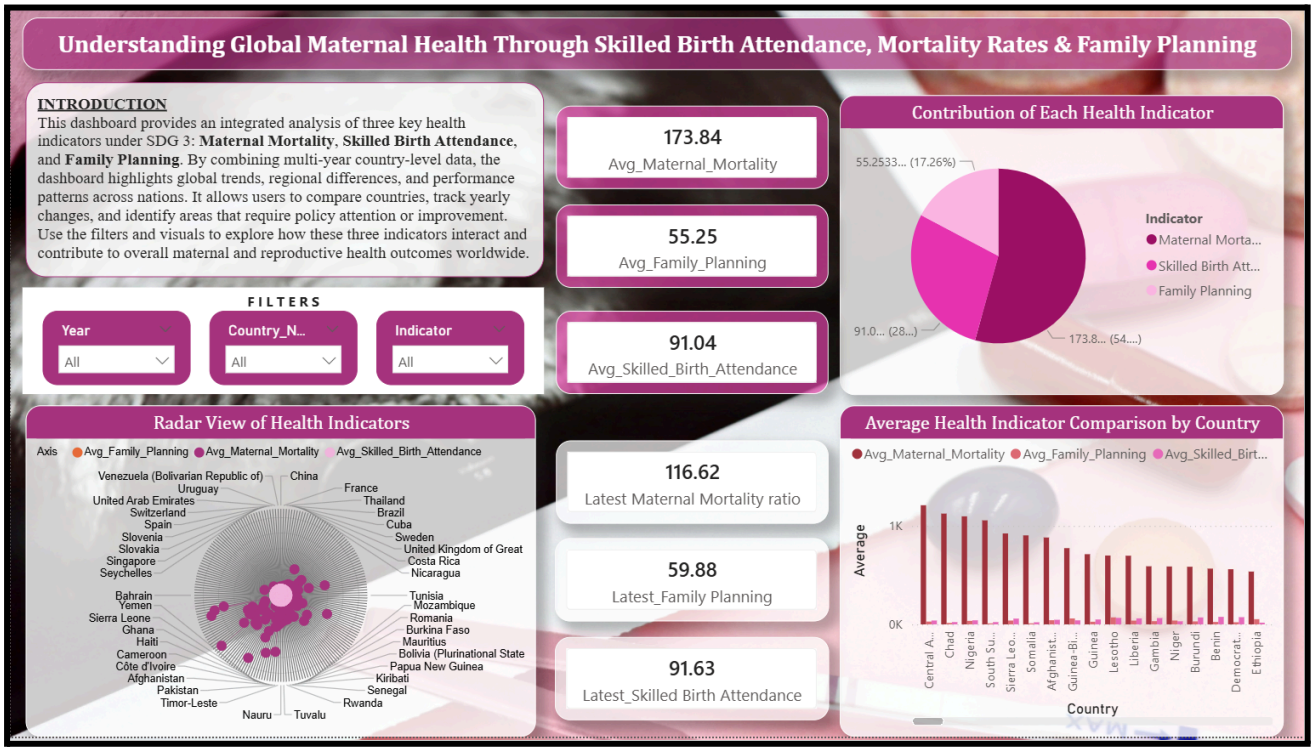
Essentially, this calculation via the variable MaxFP finds the maximum value of [Avg_Family_Planning] over all years. The function then looks for the most recent year that has this maximum Family Planning value.



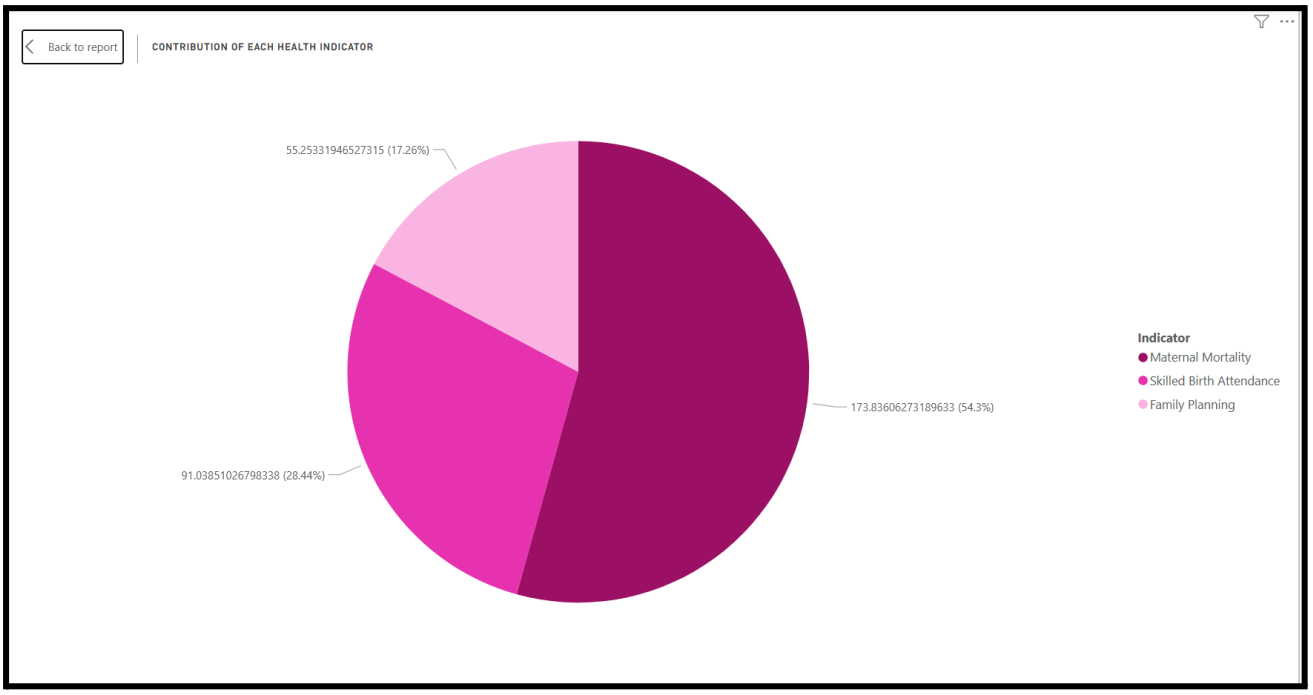
The diagram presents the data model relationships that form a star schema structure with the Countries table as the central lookup (dimension) table connected to three fact tables: 'Goal 3 1 1_Maternal Mortality', 'Goal 3 1 2_Skilled Birth Attendance', and 'Goal 3 7 1_Family Planning'.

5. Data Visualizations

Dashboard 1 - comparison and overview



Contribution of each health indicators (pie chart)



This pie chart shows how much each health indicator contributed to the total, making it clear that

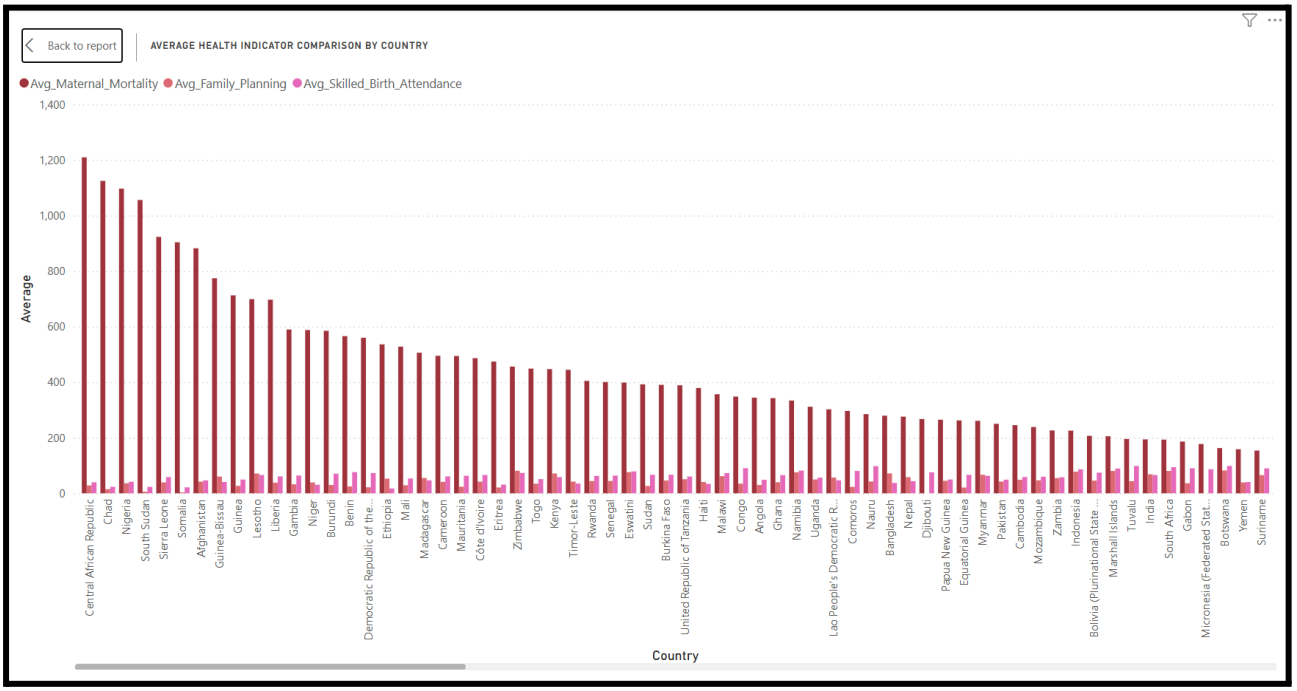
Maternal Mortality is the largest contributor by far, making up over half, 54.3% (173.63), of the total.

After that, Skilled Birth Attendance is at 28.44% (91.04), thus, approximately half of the Maternal Mortality contribution value.

Family Planning is only one-third of the total of Maternal Mortality, that is 17.26% (55.25).

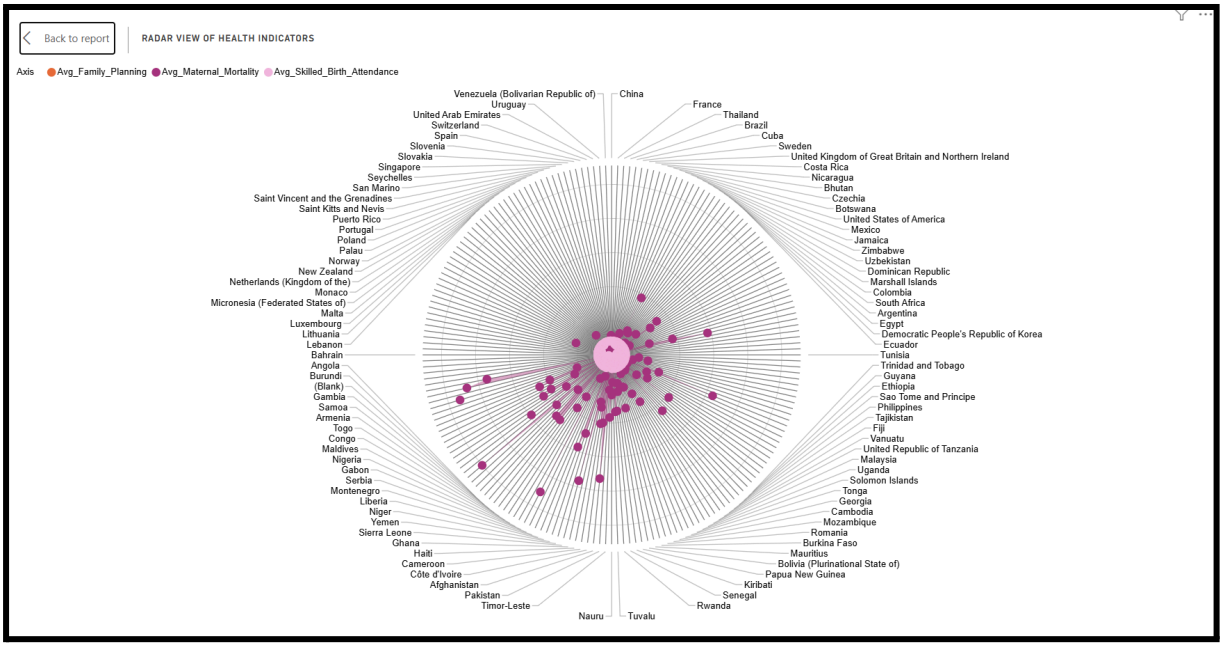
The pie chart is an appropriate way to visually present the proportion of each of the three health indicators in relation to their total.

Average health indicators comparison by country(clustered column chart)



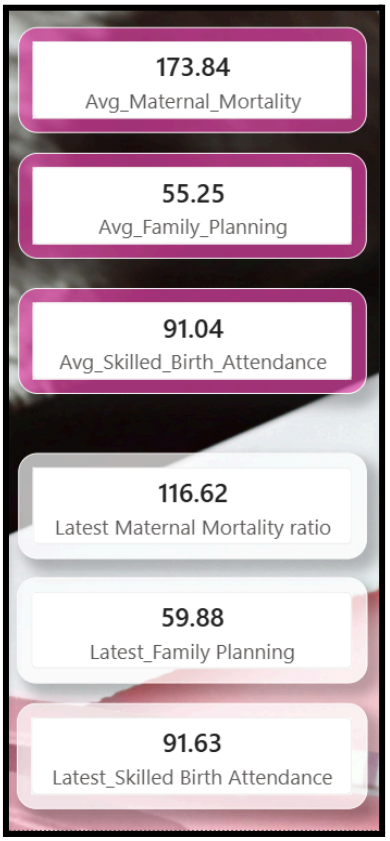
This Clustered Column Chart compares average health indicators by country for three indicators: Average Maternal Mortality (dark red), Average Family Planning (light pink), and Average Skilled Birth Attendance (purple). The chart is ordered by Average Maternal Mortality, thus the Central African Republic is shown to have the highest average (over 1,200) followed by Chad and Nigeria. In the majority of countries, the Average Maternal Mortality is significantly higher than the averages for Family Planning and Skilled Birth Attendance, which are still at a low level across all countries, generally less than 100. The chart type is a Clustered Column Chart, which is very suitable for visually comparing the magnitude of these three health indicators across a large number of countries.

Health indicators(Radar chart)



This Radar Chart shows the Radar View of Health Indicators, which is the combined performance of countries across three health indicators: Family Planning, Maternal Mortality, and Skilled Birth Attendance. The chart is revolving around a cluster of points, which implies that most countries have a relatively similar, maybe moderate, collective performance of the three indicators. Nevertheless, there are quite a few outliers, denoted by the points stretching outward along the axes, for instance, Venezuela, China, France, and Thailand on the right, and Timor-Leste, Nauru, and Tuvalu at the bottom. The chart kind is a Radar Chart, which is employed here to make a visual comparison of multiple variables (the three indicators) for a large number of countries.

Key health indicator summary(KPI summary cards)

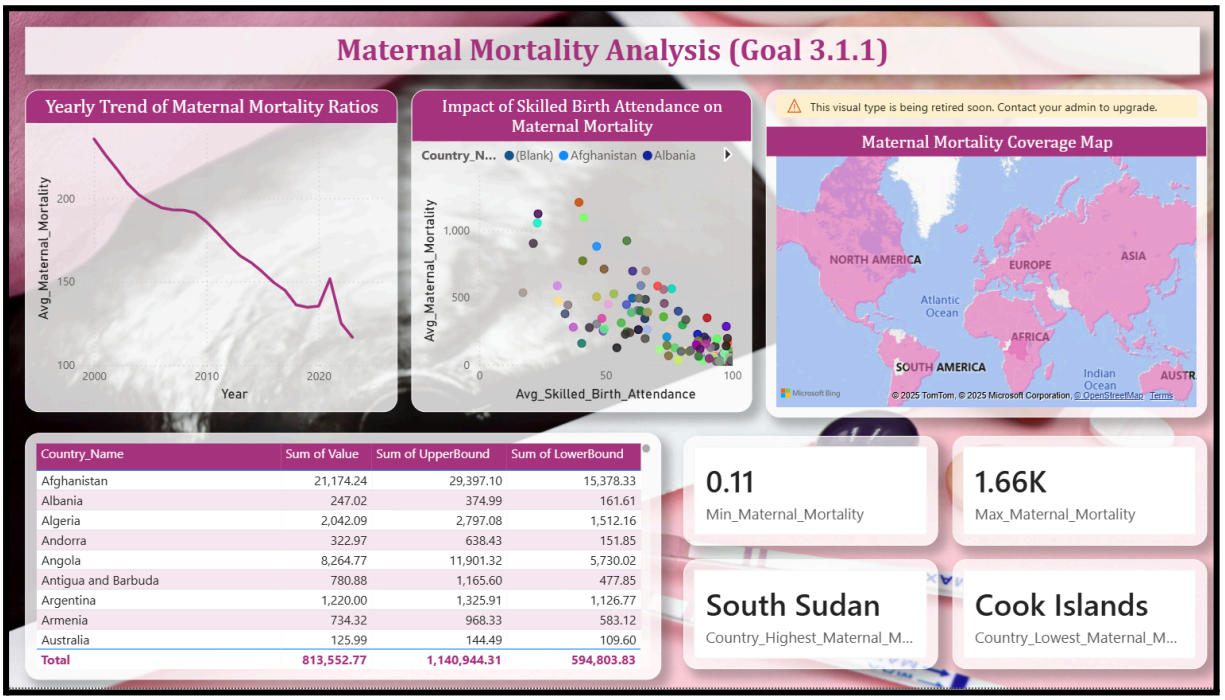


The visualization displays the summary of key health indicators through six numerical tiles i.e. the Card format. The tiles are classified into average values and latest values for three health indicators:

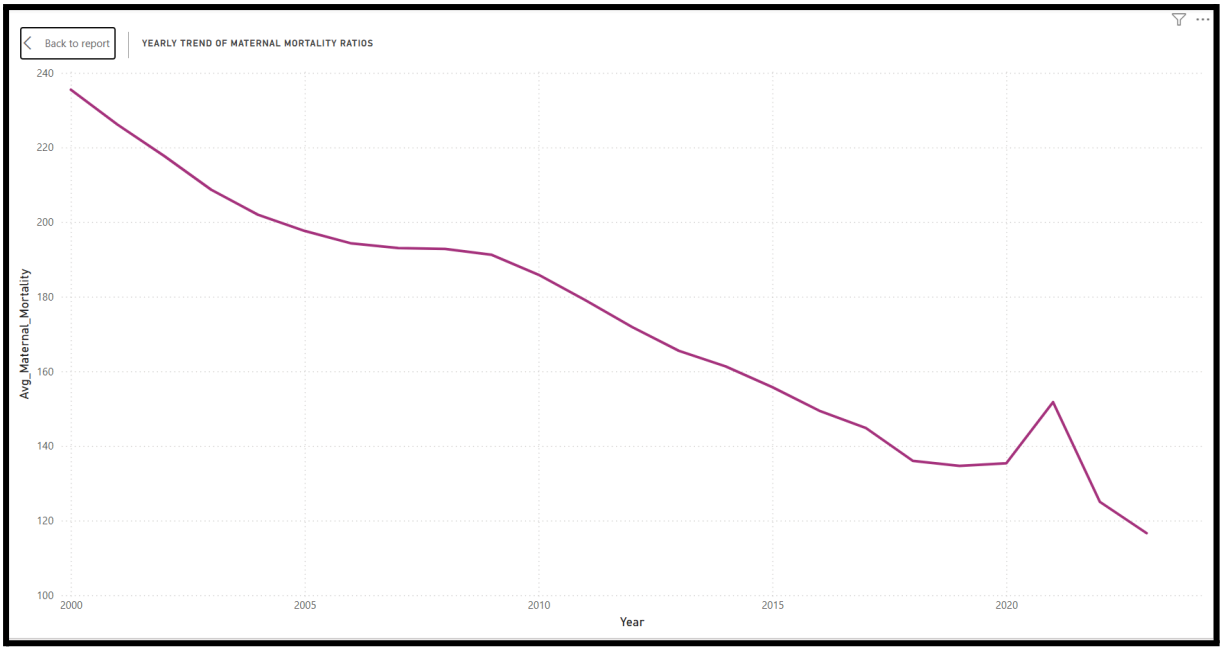
Average Maternal Mortality is leading with 173.84, followed by Average Skilled Birth Attendance at 91.04, and Average Family Planning at 55.25. The latest values corresponding to the above are Latest Maternal Mortality ratio at 116.62, Latest Skilled Birth Attendance at 91.63, and Latest Family Planning at 59.88.

The visualization is a Card Visualization which basically works as a straightforward dashboard to visually present the essential metrics in a quick view.

Dashboard 2 - comparison and overview

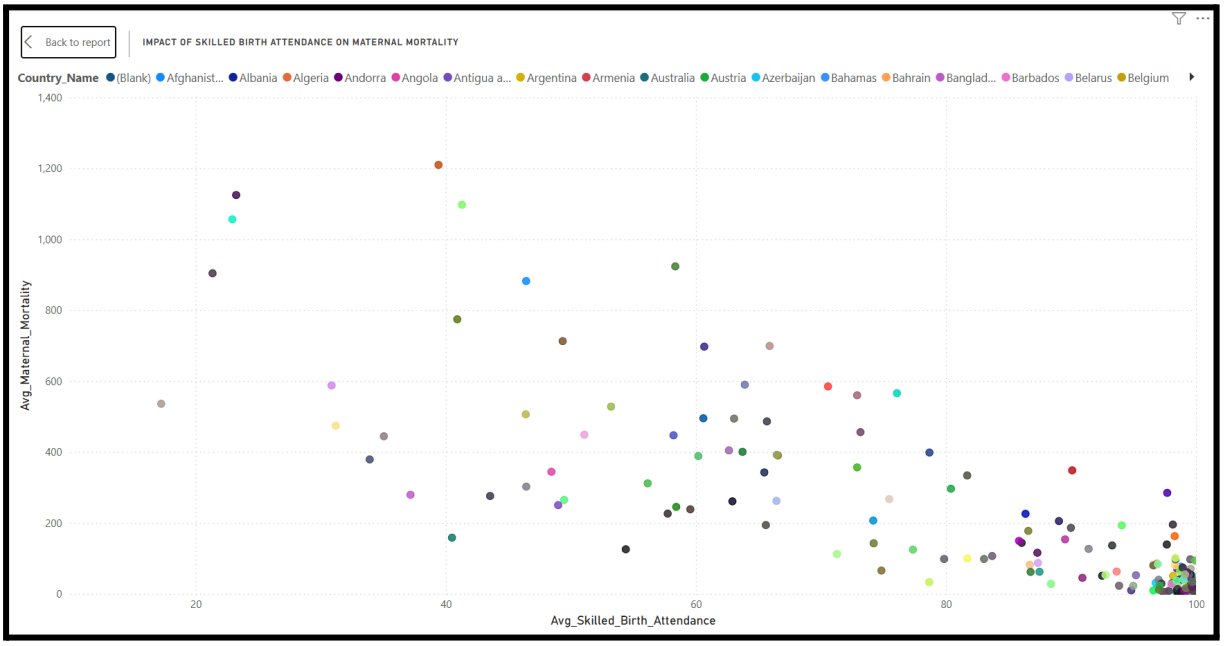


Yearly trends of maternal mortality ratios(line chart)



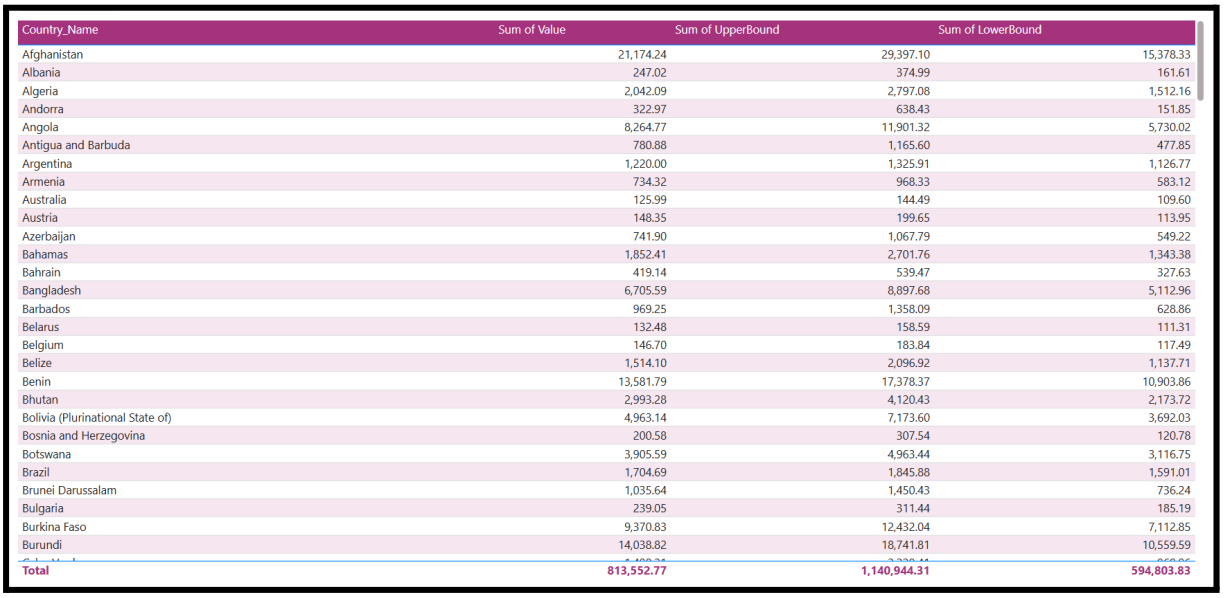
The yearly average maternal mortality ratio as depicted in the line chart titled Yearly Trend of Maternal Mortality Ratios is going down for the most part of the years from 2000 to the current time. The ratio is very high (more than 240) around 2000 and it keeps going down all the way, dropping below 140 around 2018-2019. The trend line shows a very sharp, though short-lived, increase around 2021 when the ratio rises for a short time to more than 150 and then goes down quickly to continue its decline to the lowest point on the chart, which is a little less than 120. The chart type is a Line Chart, which is ideal for visualizing trends over time.

Impact of Skilled Birth Attendance on Maternal Mortality(scatter chart)



This scatter chart named Impact of Skilled Birth Attendance on Maternal Mortality displays the average maternal mortality ratio (Y-axis) versus the average skilled birth attendance (X-axis) for different countries. The chart shows a negative correlation overall, which means that a higher average skilled birth attendance corresponds to a lower average maternal mortality ratio. Those countries where the skilled birth attendance is less than 40 are likely to have the highest maternal mortality (even more than 1,200), while countries with an attendance of more than 80 usually have maternal mortality under 400, and quite often under 200. Such a trend implies that elevating skilled birth attendance might be indispensable for lowering maternal mortality.

Country-Level Health Indicator Totals (Table Visualization)



Country_Name	Sum of Value	Sum of UpperBound	Sum of LowerBound
Afghanistan	21,174.24	29,397.10	15,378.33
Albania	247.02	374.99	161.61
Algeria	2,042.09	2,797.08	1,512.16
Andorra	322.97	638.43	151.85
Angola	8,264.77	11,901.32	5,730.02
Antigua and Barbuda	780.88	1,165.60	477.85
Argentina	1,220.00	1,325.91	1,126.77
Armenia	734.32	968.33	583.12
Australia	125.99	144.49	109.60
Austria	148.35	199.65	113.95
Azerbaijan	741.90	1,067.79	549.22
Bahamas	1,852.41	2,701.76	1,343.38
Bahrain	419.14	539.47	327.63
Bangladesh	6,705.59	8,897.68	5,112.96
Barbados	969.25	1,358.09	628.86
Belarus	132.48	158.59	111.31
Belgium	146.70	183.84	117.49
Belize	1,514.10	2,096.92	1,137.71
Benin	13,581.79	17,378.37	10,903.86
Bhutan	2,993.28	4,120.43	2,173.72
Bolivia (Plurinational State of)	4,963.14	7,173.60	3,692.03
Bosnia and Herzegovina	200.58	307.54	120.78
Botswana	3,905.59	4,963.44	3,116.75
Brazil	1,704.69	1,845.88	1,591.01
Brunei Darussalam	1,035.64	1,450.43	736.24
Bulgaria	239.05	311.44	185.19
Burkina Faso	9,370.83	12,432.04	7,112.85
Burundi	14,038.82	18,741.81	10,559.59
Total	**813,552.77**	**1,140,944.31**	**594,803.83**

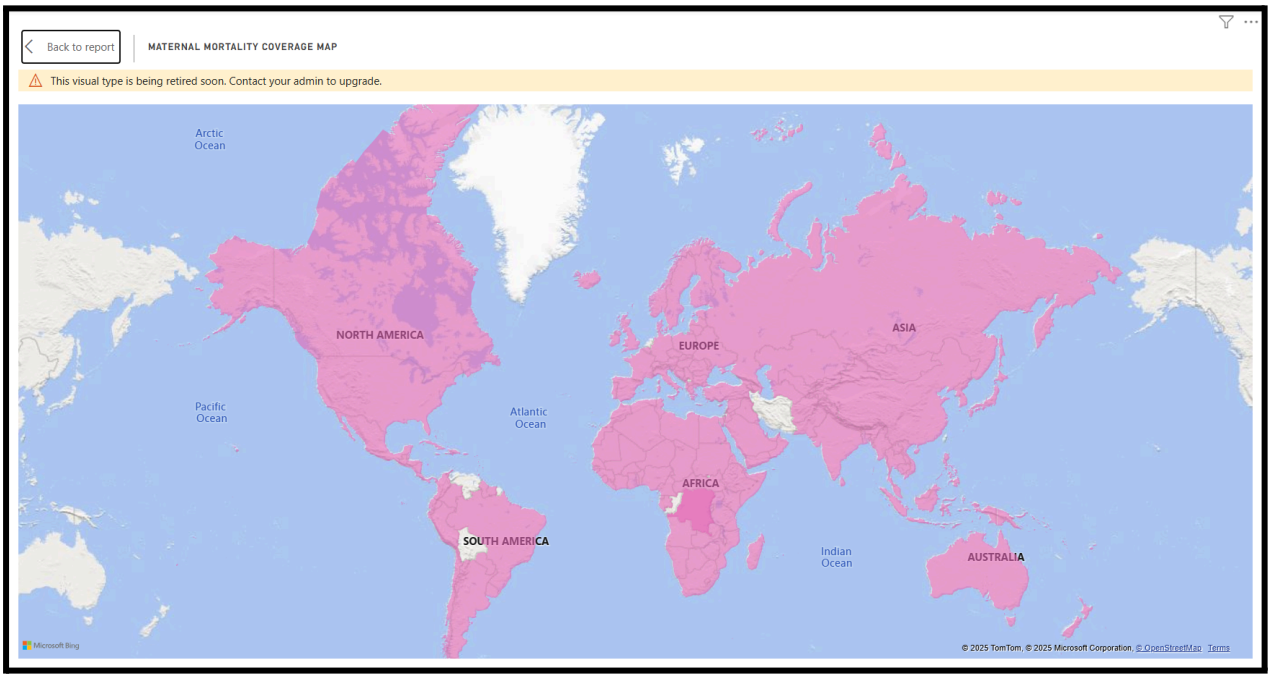
Country-Level Health Indicator Totals by Country is a Table Visualization to show the breakdown Sum of Value, Sum of UpperBound, and Sum of LowerBound totals for different health indicators (the table does not explicitly state the health indicators, but they can be inferred from the surrounding charts) for a list of countries.

The table is organized by country alphabetically, with each country's totals listed. For example, Afghanistan has a Sum of Value of 21,174.24, an UpperBound of 29,397.10, and a LowerBound of 15,378.33.

The overall total for Sum of Value is 813,552.77 for all the countries listed.

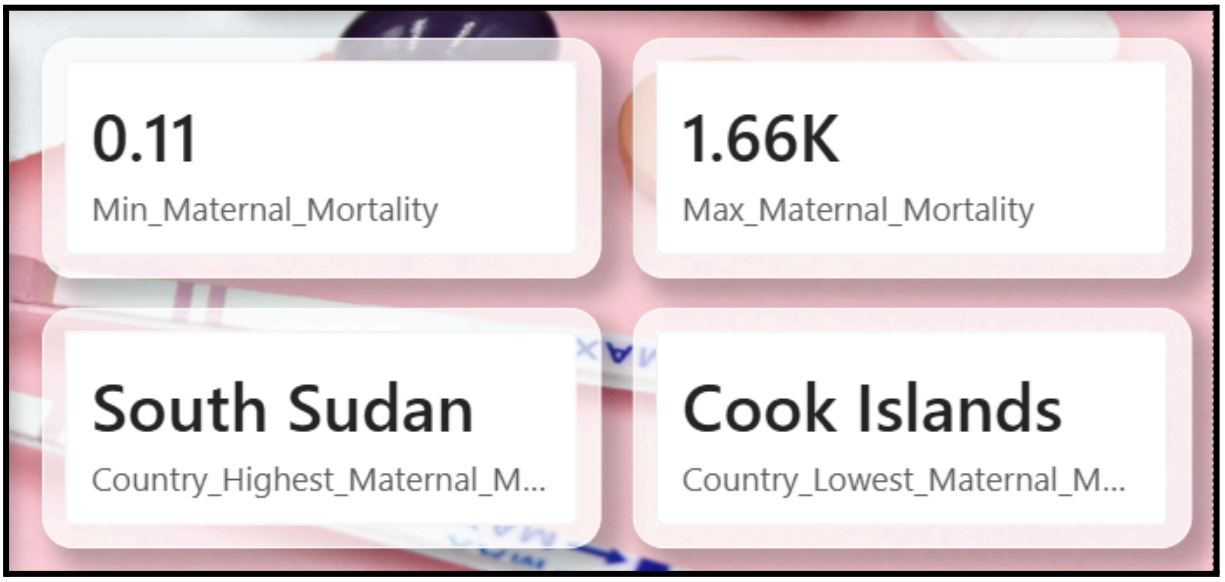
The chart type is a Table Visualization, which is utilized to display exact, concise numerical data for easy comparison and reference.

Maternal Mortality Coverage Map



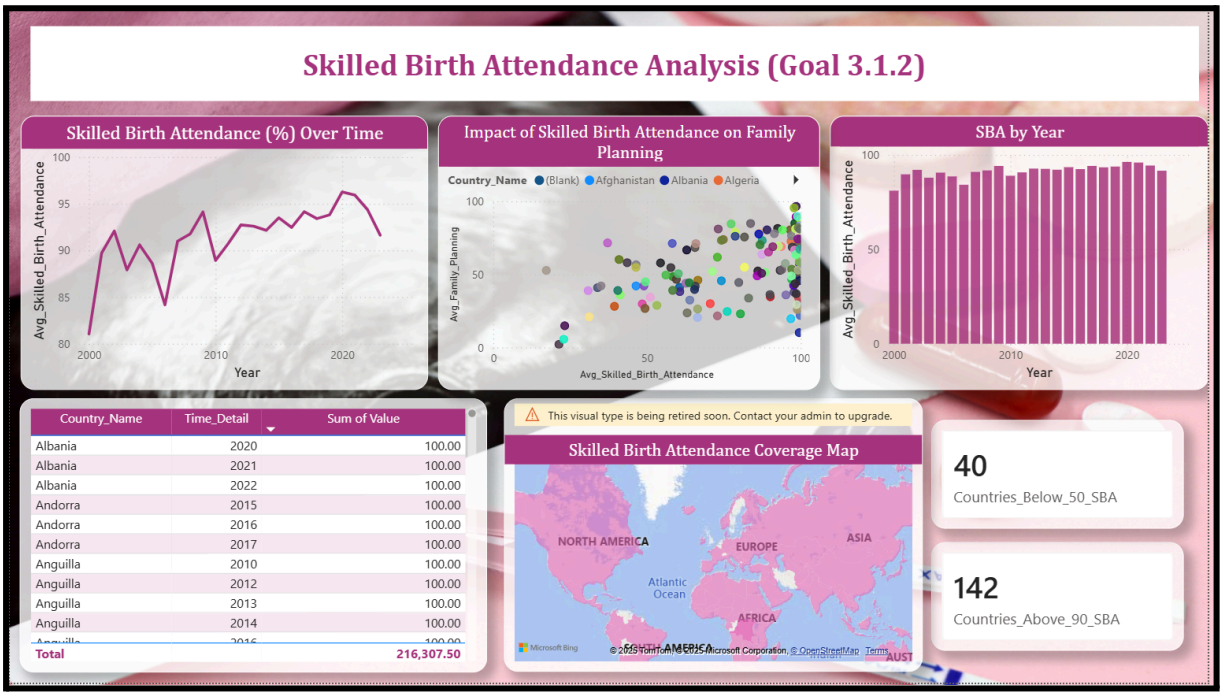
This choropleth map named Maternal Mortality Coverage Map illustrates the worldwide geographic coverage of maternal mortality data. Pink color delineates the large areas and countries where maternal mortality figures are accessible, thus almost all of North America, South America, Europe, Asia, and Australia are covered by the data. The map indicates that maternal mortality is backed up by data from very broad sources internationally with just a handful of uncolored (white) spots mostly around Greenland, North Africa, and some central parts of Africa.

Maternal mortality extremes(KPI summary cards)

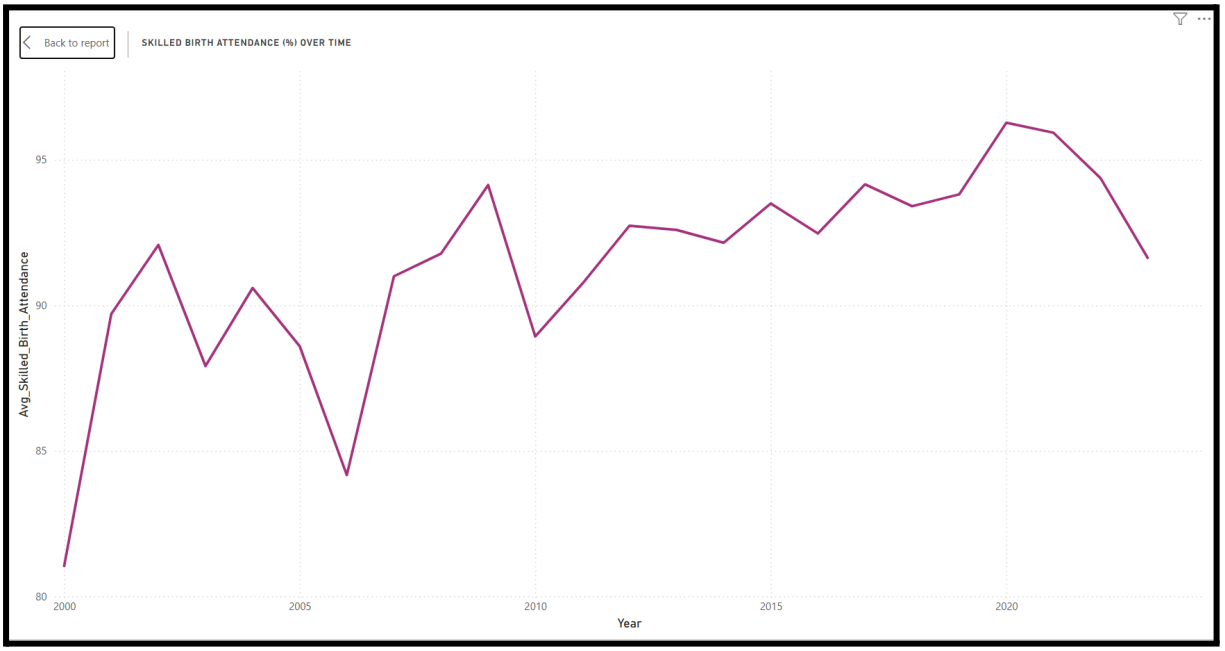


This Card Visualization named "Maternal Mortality Extremes" shows four essential summary statistics of maternal mortality. The first statistic is the minimum maternal mortality ratio that was 0.11. The second maternal mortality ratio to maximum is 1.66K (1,660). The highest maternal mortality country is South Sudan, while the lowest maternal mortality country is the Cook Islands. The chart type is a Card Visualization that serves the purpose of readily locating extreme values and the respective countries.

Dashboard 3 - comparison and overview

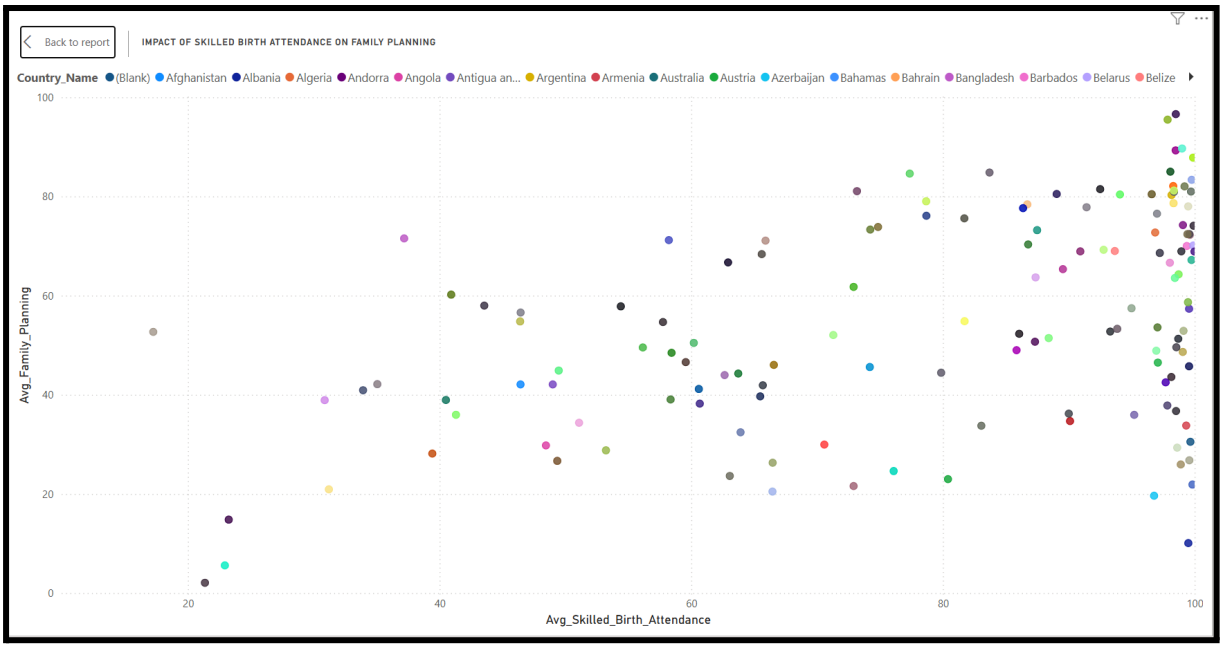


Skilled birth attendence over time (Line chart)



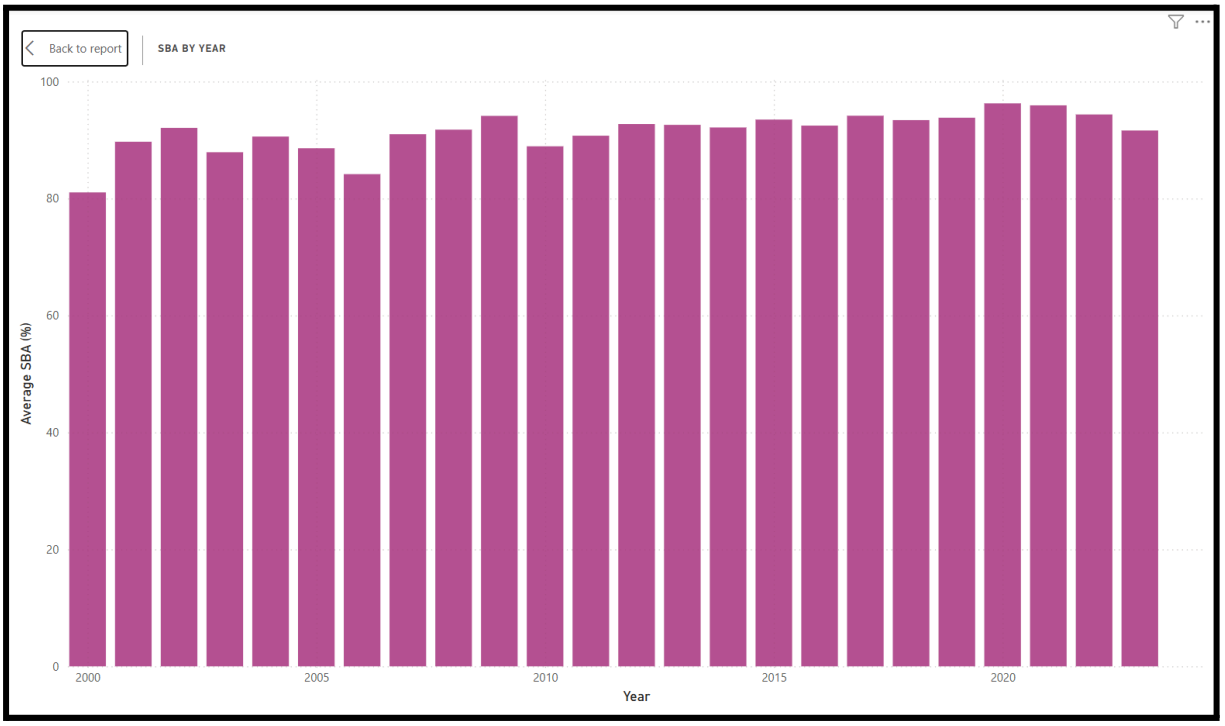
The line chart illustrates the percentage of skilled birth attendance that changed over time. It shows the average percentage of skilled birth attendance fluctuating, but mainly increasing from the year 2000 to now. The trend had a starting point of an average of about 81% in 2000 and made a lot of ups and downs but finally went over 95% around 2019-2020. Following this peak, the percentage experiences a significant drop, going back to around 92% by the end of the period. So, the average skilled birth attendance percentage is still greater at the end of the period than at the beginning, albeit there were a few short-term drops (for instance, around 2006 and 2010).

Impact of skilled birth attendance on family planning (Scatter chart)



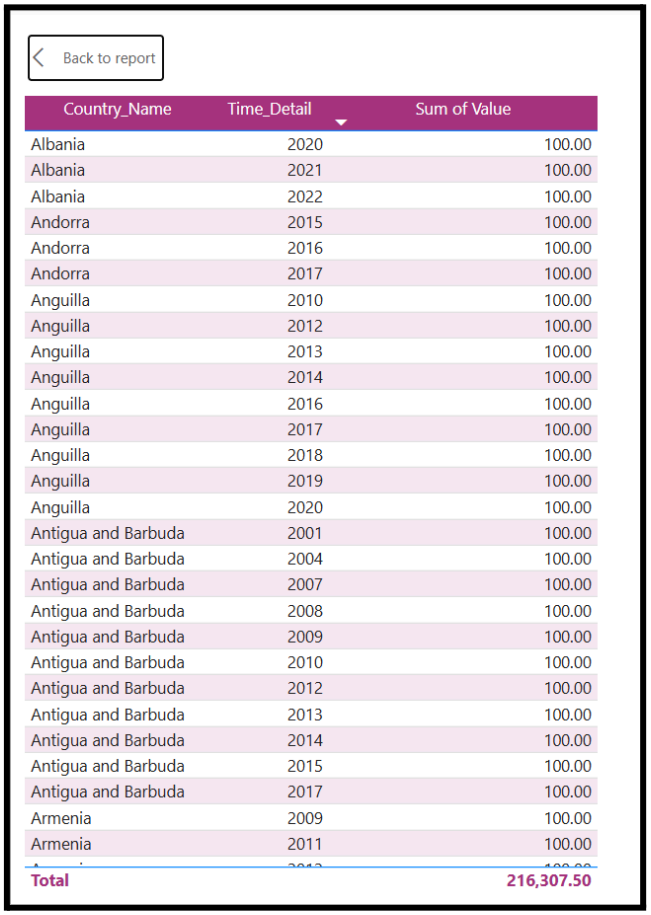
This scatter chart, titled 'Impact of Skilled Birth Attendance on Family Planning,' visually presents the relationship between the average family planning percentage (Y-axis) and the average skilled birth attendance percentage (X-axis) for different countries. The data points distribution exhibits an overall pattern where a higher percentage of skilled birth attendance is weakly correlated with a higher percentage of family planning in most cases. A majority of countries are concentrated in the upper right quadrant, which implies reasonably high average values for both indicators (more than 60% for Skilled Birth Attendance and more than 40% for Family Planning). Nevertheless, there are substantial exceptions, for instance, the case of countries with high skilled birth attendance (more than 90%) and extremely low family planning rates (less than 20%). The present chart is a scatter chart, which is appropriate for exploring the possible association between these two health indicators.

SBA by year (Bar chart)



This is a bar chart titled "SBA BY YEAR" that traces the changing trend of the Average SBA (%) over a time span of roughly 23 years, starting from the year 2000 and going till around 2023. From the chart, it is evident that the average SBA percentage has been quite stable and high for most of the years, hovering between 80% and 100% for the entire duration. Although there are slight changes from one year to another, the percentage remains very stable, and the last couple of years (approximately 2020 and 2021) have the highest values of the series, always close to the 95% level.

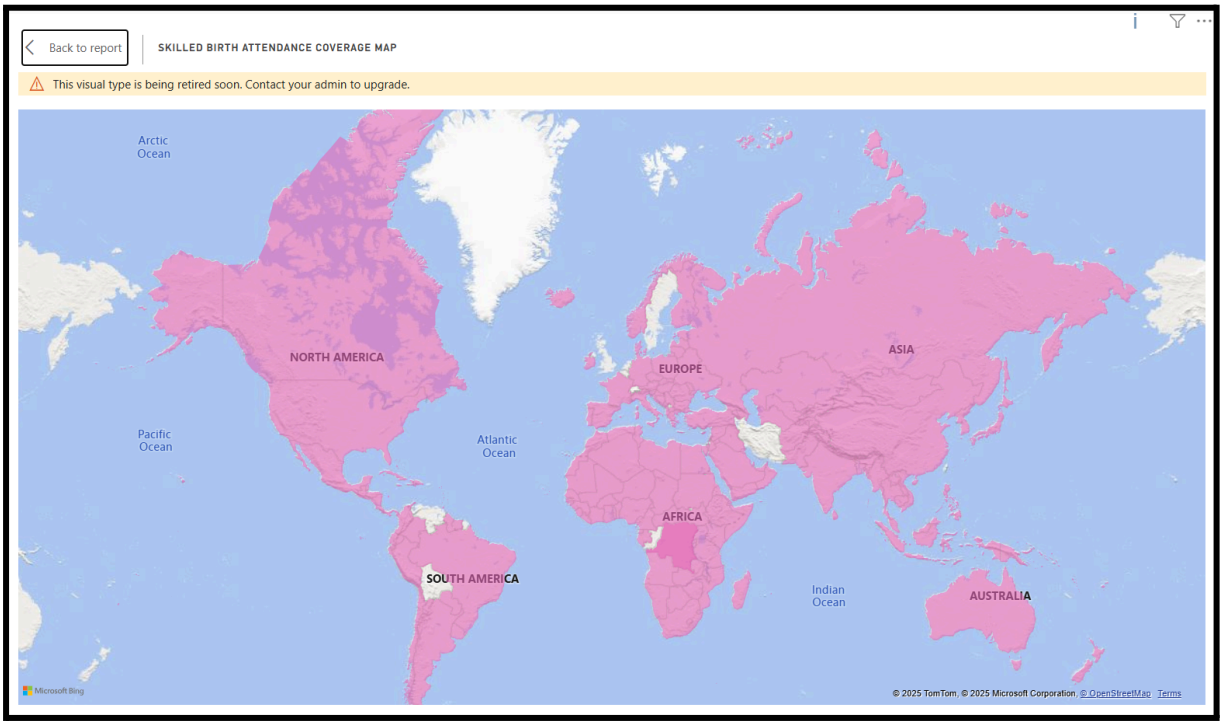
Country value sum by year (Table chart)



Country_Name	Time_Detail	Sum of Value
Albania	2020	100.00
Albania	2021	100.00
Albania	2022	100.00
Andorra	2015	100.00
Andorra	2016	100.00
Andorra	2017	100.00
Anguilla	2010	100.00
Anguilla	2012	100.00
Anguilla	2013	100.00
Anguilla	2014	100.00
Anguilla	2016	100.00
Anguilla	2017	100.00
Anguilla	2018	100.00
Anguilla	2019	100.00
Anguilla	2020	100.00
Antigua and Barbuda	2001	100.00
Antigua and Barbuda	2004	100.00
Antigua and Barbuda	2007	100.00
Antigua and Barbuda	2008	100.00
Antigua and Barbuda	2009	100.00
Antigua and Barbuda	2010	100.00
Antigua and Barbuda	2012	100.00
Antigua and Barbuda	2013	100.00
Antigua and Barbuda	2014	100.00
Antigua and Barbuda	2015	100.00
Antigua and Barbuda	2017	100.00
Armenia	2009	100.00
Armenia	2011	100.00
Total		**216,307.50**

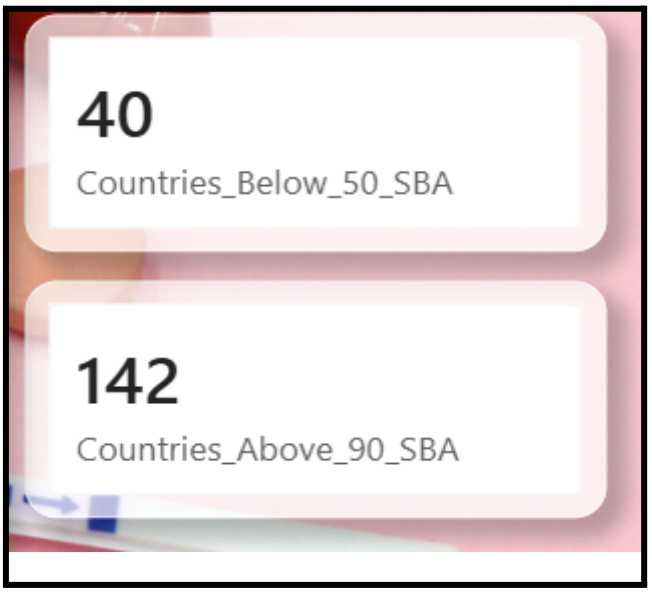
This picture shows a Table Chart that collects the Sum of Value for different countries over several years. Each entry value is $100.00 consistently. The table is organized by Country_Name (the first five countries visible are Albania, Andorra, Anguilla, Antigua and Barbuda, and Armenia) and year. The total of the Sum of Value for the visible rows is $500.00. The grand total for the Sum of Value over all the underlying data is $216,307.50$, which tells that the complete dataset contains a large number of country-year entries entries.

Skilled birth attendance coverage map



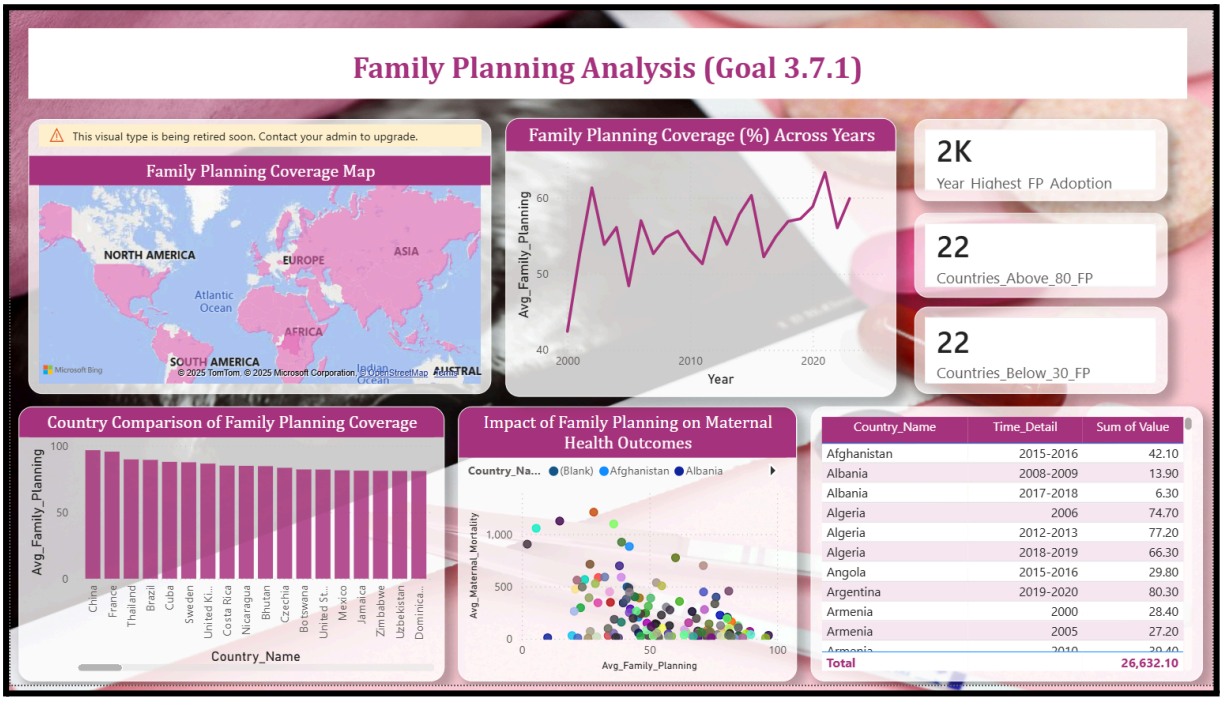
This picture shows an SKILLED BIRTH ATTENDANCE COVERAGE MAP Map Chart that depicts the geographic extent of data coverage for "Skilled Birth Attendance" (SBA) through a visual means. The chart makes use of different color coding to indicate the areas covered by data or reporting for Skilled Birth Attendance. The pink areas cover a large number of regions, such as whole continents of North America and South America, almost the entirety of Europe and Asia, as well as Australia, thus indicating that data or reporting for Skilled Birth Attendance is available or applicable in these regions. In contrast, the white or uncolored areas, which are mainly the very northernmost parts of North America and Eurasia, as well as the few small isolated areas in South America and Africa, stand for regions where the data coverage may be absent or that have not been reported.

Key Performance Indicators for SBA Coverage (KPI summary cards)

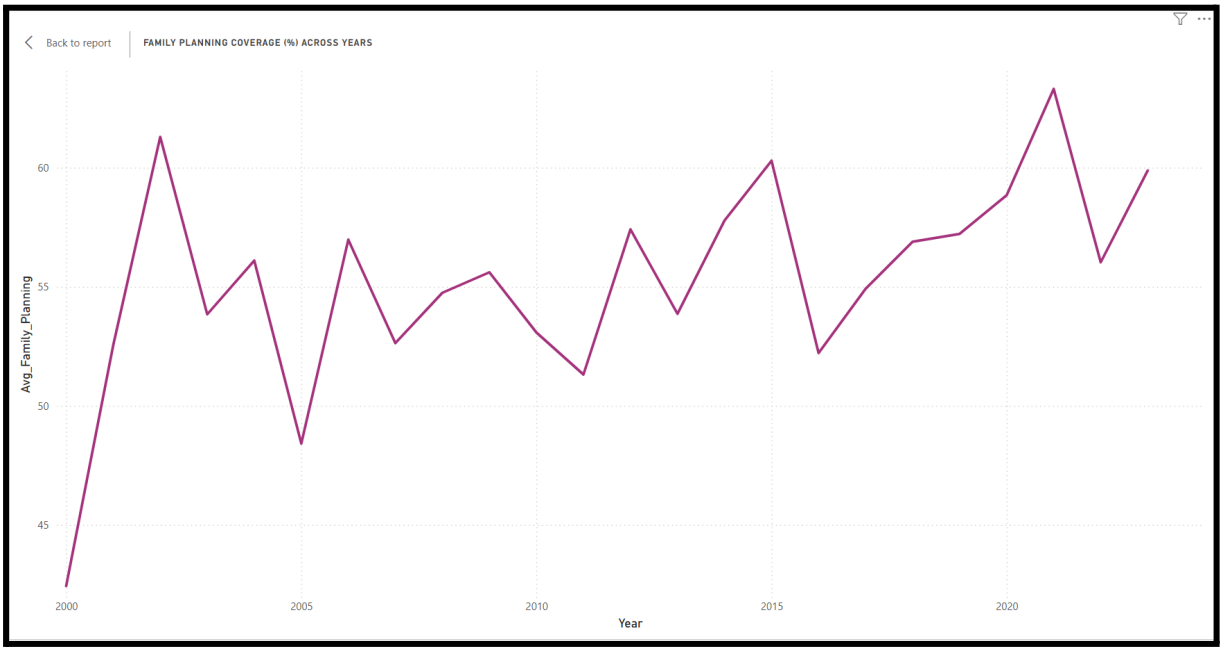


The visualization in this picture is a pair of summary metrics highlighting the coverage of Skilled Birth Attendance (SBA) across the world. The first card communicates that 40 countries are recording less than 50% of the SBA rate. The second card, on the other hand, brings out a brighter picture, saying that 142 countries have an SBA percentage of more than 90%. These two measures offer an instant global map of how SBA coverage is spread worldwide, showing a stark divide between the few countries with low coverage and the vast majority of countries with high coverage.

Dashboard 4 - comparison and overview

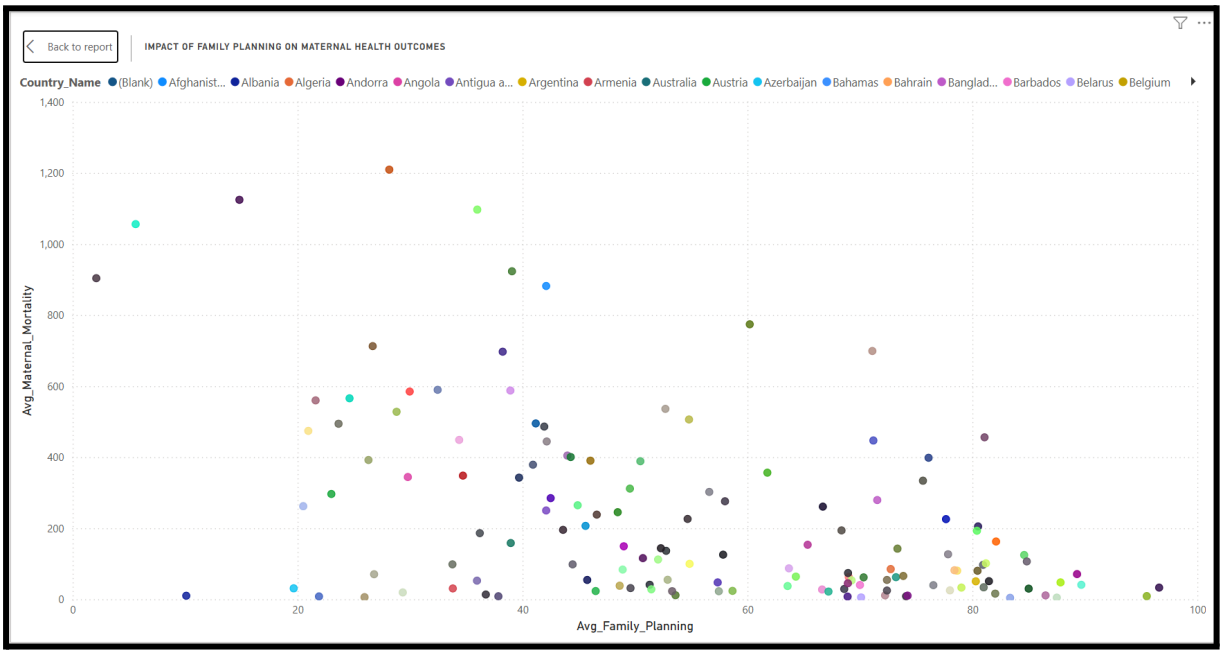


Family Planning Coverage (%) Across Years (Line chart)



This graph is a line graph that visualizes the average family planning coverage percentage over time from the year 2000 to about 2022. The percentage of coverage varies greatly throughout the period. It is very low at around 43% in 2000, rapidly goes above 60% at around 2001 and then oscillates but generally remains between 50% and 60%. It can be seen that the highest points are at around 2001, 2015, and the highest point is at around 2021, whereas the lowest point after the initial ascent is at around 2004 that goes down to less than 50%. The coverage, therefore, shows an upward trend when the initial and final points of the data available are compared, albeit there are several valleys and peaks.

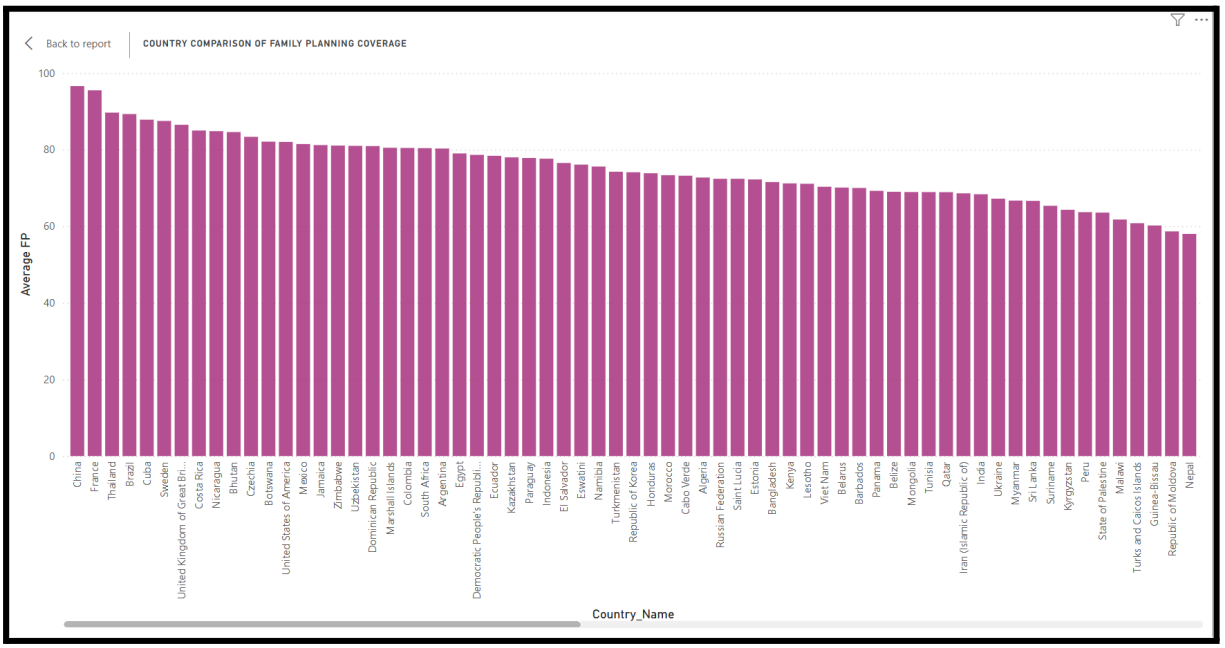
Impact of Family Planning on Maternal Health Outcomes (scatter plot)



This chart is a Scatter Plot that investigates the connection between Average Family Planning Coverage (%) represented on the x-axis and Average Maternal Mortality on the y-axis, while each marker stands for a particular country. The graph illustrates a negative correlation between the two variables. When the average family planning coverage percentage goes up (moving to the right along the x-axis), the average maternal mortality is decreasing most of the time (the data points trend lower).

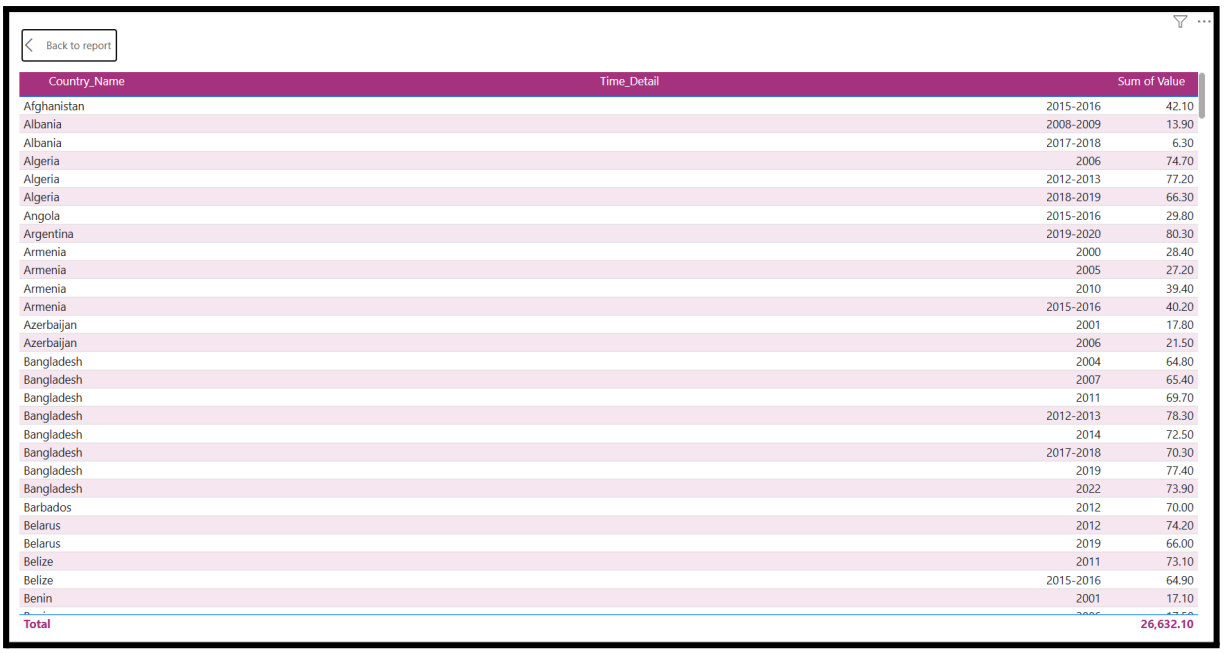
As an example, countries with extremely low family planning coverage (less than 30%) show maternal mortality varying very widely, reaching the highest values (up to 1,200), on the other hand, countries with high family planning coverage (more than 80%) almost exclusively have low maternal mortality values (mostly less than 200), thus, it can be inferred that higher family planning coverage leads to better maternal health outcomes.

Country comparison on family planning coverage (Bar chart)



It is very clear from the graph that coverage levels change dramatically all over the world. China is the country with the average FP coverage of nearly 100% which is followed by France and Thailand closely. It is likely that coverage lowers across the figure, and many countries are located between 70% and 90%. The countries illustrated on the right of the graph such as the Republic of Moldova, Nepal, and Guinea-Bissau show the lowest average FP coverage which is around 50% to 60%, as it appears.

Family Planning Coverage Trends for Select Countries (Table chart)



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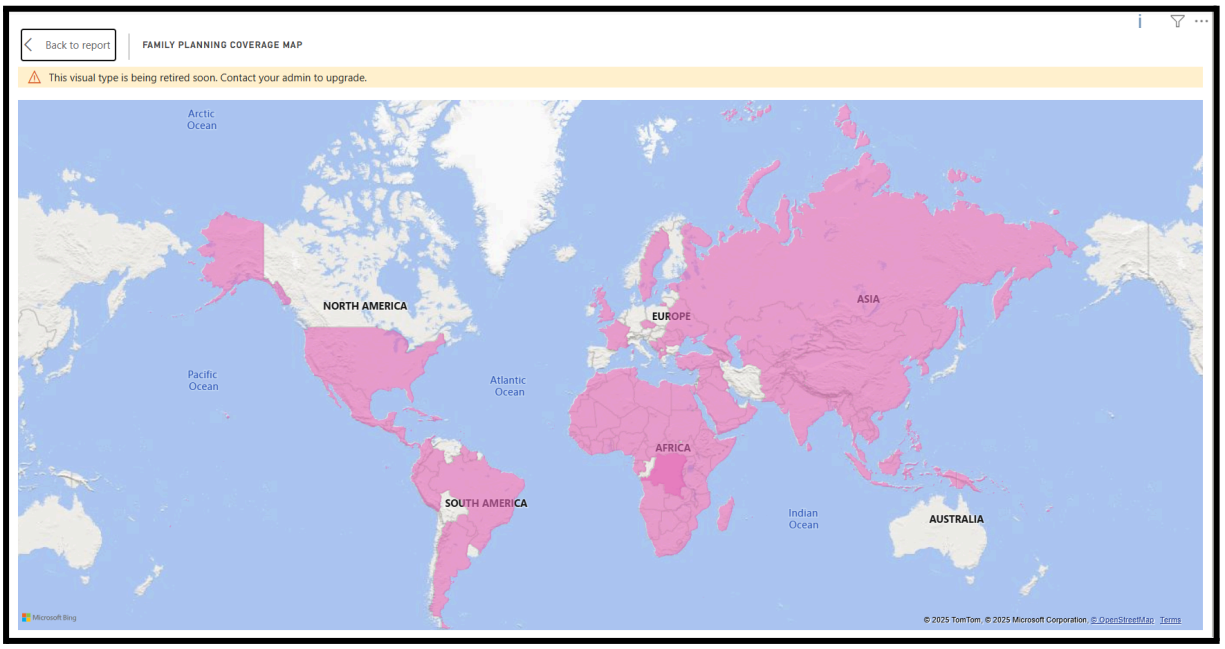
Country_Name	Time_Detail	Sum of Value
Afghanistan	2015-2016	42.10
Albania	2008-2009	13.90
Albania	2017-2018	6.30
Algeria	2006	74.70
Algeria	2012-2013	77.20
Algeria	2018-2019	66.30
Angola	2015-2016	29.80
Argentina	2019-2020	80.30
Armenia	2000	28.40
Armenia	2005	27.20
Armenia	2010	39.40
Armenia	2015-2016	40.20
Azerbaijan	2001	17.80
Azerbaijan	2006	21.50
Bangladesh	2004	64.80
Bangladesh	2007	65.40
Bangladesh	2011	69.70
Bangladesh	2012-2013	78.30
Bangladesh	2014	72.50
Bangladesh	2017-2018	70.30
Bangladesh	2019	77.40
Bangladesh	2022	73.90
Barbados	2012	70.00
Belarus	2012	74.20
Belarus	2019	66.00
Belize	2011	73.10
Belize	2015-2016	64.90
Benin	2001	17.10
Total		26,632.10

This chart represents a table showing time-series data of the percentage of family planning coverage in different countries such as Afghanistan, Albania, Algeria, Angola, Armenia, Azerbaijan, Bangladesh, Barbados, Belarus, Belize, and Benin.

The table provides information on the Country Name, the specific Time Detail (Year or Range of Years) when the data was collected, and the corresponding Sum of Value, which indicates the percentage of Family Planning Coverage.

For instance, Albania's FP coverage was 13.90% in 2008-2009 and 6.30% in 2017-2018, whereas Bangladesh's coverage went up from 64.80% in 2004 to 73.90% in 2022.

Global family planning coverage map



This diagram is a Map showing in a visual manner the location of the Worldwide Distribution of Family Planning Coverage. The regions colored in pink/magenta show the countries or regions for which family planning coverage data have been recorded and are presumably those areas active in the dataset, whereas the uncolored (white/grey) regions are the ones where no data have been represented. The continents of Asia, Europe, North America (that is the US and some parts of Canada/Mexico), South America, and good portions of Africa are covered and have been colored, which indicates that the family planning data have been geographically far-reaching.

6. Reflective analysis

The early stages of data importing and preparation of the UN SDG data were associated with some technical issues. The biggest obstacle was that the downloaded global datasets were in unstructured format and frequently years were recorded as headers instead of a single column called Year. This involved a critical unpivot operation in the power query editor to convert the data into a long and not the wide form, a requirement to analyse time-series in power BI. Also, the information had to be thoroughly cleaned and transformed into types. As the indicator values might be represented as text because of non-numeric values (e.g., metadata or notes in the raw file), T-SQL and Power Query were required to systematically process missing or inconsistently recorded values and make numeric or date values types assigned to the numbers and dates respectively to calculate and chart the data correctly. The next data modelling involved the definition of a logical structure to connect different metrics, such as Maternal Mortality (3.1.1) and Family Planning (3.7.1), frequently by common keys, including Country_Name and Year to facilitate the analysis of the indicators on the primary dashboard.

A number of sophisticated Power BI functions were carefully used in order to get valuable insights and draw a professional quality dashboard. DAX Advanced became necessary to go beyond basic aggregations, in particular, to execute Time Intelligence functionality (e.g., Year-over-Year change) and calculate dynamical KPIs to measure the performance of the world and the countries. To make the storytelling and user experience, the Bookmarks and Drill-throughs were also adopted to make the navigational flow logical, through which the user would navigate the high-level understanding of the topic of Global Maternal Health, which would be the high-level summary page, to the more specific detail page of each indicator. Custom Visuals were also used to enhance visualization and this is how a Radar Chart was introduced, allowing simultaneous multi-dimensional comparison of countries based on all three SDG indicators--the ability that the usual visuals could not have.

The review indicated three urgent tendencies in relation to world development on SDG 3. To begin with, there was a general positive change since 2000 in the decreasing Maternal Mortality Ratio (MMR), as well as, the rising Skilled Birth Attendance (SBA). Second, the dashboard revealed substantial and intolerable geographical differences, where the highest level of MMR and lowest level of coverage SBA and Family Planning (FP) is mostly concentrated in certain areas, which is a good indicator of leaving no one behind. Above all, the scatter plots have given quantitative data about high negative correlation; the nations with high SBA have high FP coverage and as such, they have low MMR. According to this trend,

effective development is possible only through dual-pronged and interconnected policy approaches as opposed to individual investments.

The integration of Power BI and the SQL Server database that served as the back end to provide the analytical process essentially enhanced data governance through a strong and scalable system that was centralized. SQL Server enabled the importation, cleaning, and normalization of global datasets of scales to be efficiently done in T-SQL, which removed most of the resource-intensive tasks in Power BI Desktop. Separation of duties also meant that Power BI functioned off of a pre-tested, formalized dataset, which drastically enhanced query response and facilitated quicker development during the design of a dashboard. Moreover, the use of SQL Server is also in line with the professional best practices of data management that will give the only source of truth that is capable of being easily updated or scaled to accommodate future analysis by the team.

7. Discussion on power BI features used

The interactive SDG dashboards were created with Power BI features that included a great use of Advanced Data Analysis Expressions (DAX) for analytical computation and data modelling. DAX played a key role in generating complex calculated measures such as Time Intelligence functions (e.g., Year-over-Year change, Cumulative Improvement Since 2015), in creating Dynamic KPIs like Countries_Above_80_FP and Min/Max_Maternal_Mortality for KPI cards, and in calculating Weighted Averages in order to facilitate accurate indicator representation.

Besides that, the dashboard made use of essential features for Interactive Visualisations and Storytelling, such as Drill-Throughs and Bookmarks to establish a guided narrative transition from the overview to the detailed indicator pages. Custom Visuals like the Radar Chart were used for the comparison of countries on different dimensions, while Filled Maps/Coverage Maps delivered the necessary geographic context.

In the end, there were also standard features like global Slicers and Filters (Year, Country) and custom Tooltips and Annotations which were geared towards user exploration and gave extra help for the complex visuals like the scatter plots.

8. Results analysis and discussion

The yearly global maternal health data analysis for SDG 3.1.1 (Maternal Mortality) demonstrates an overall positive decline in the worldwide average maternal mortality rate (MMR) since 2000. However, the improvement is quite patchy, showing considerable and lingering differences. KPI cards highlight these differences, showing that MMR South Sudan is one of the countries with the highest while the Cook Islands is one of the lowest, which implies a vast gap in basic healthcare access. The Max_Maternal_Mortality KPI of 1.66K graphite dramatically underscores the need for policy intervention without delay. Besides that, the trend line of the rate also signals that the rate at which MMR has gone down might have slowed lately, although it has been initially rapid.

Indicators on SDG 3.1.2: Skilled Birth Attendance (SBA) provide clear evidence of a substantial worldwide growth, and the SBA by Year chart shows a global average of about 91.04% in the last data points. Yet, this high coverage conceals the persistence of the Last Mile Challenge. The SBA Coverage Map and the KPI reporting 40 countries with less than 50% SBA demonstrate a critical group of countries that are very far from reaching universal high coverage. These countries are highly conceivable to have faced serious barriers due to fragile settings, rural access, or conflicts resulting in lack of universal high coverage despite the global progress.

Most importantly, the analysis provides strong evidence for the indicators' interdependence, which is essential for integrated policymaking. The SDG 3.7.1, Family Planning (FP) Coverage (about 55.25% globally) shows trends that are generally improving, albeit with some fluctuations. The most important thing is that the KPI identifying 22 countries with less than 30% FP coverage pinpoints the huge unmet need which becomes the main obstacle in the reduction of maternal mortality. The scatter plots on the dashboards serve as a quantitative means for the link, revealing a strong negative correlation: countries with better SBA and FP coverage are constantly those with the lowest Maternal Mortality Ratios. This strong association is in line with the idea of a dual approach that simultaneously supports the strengthening of maternal care and the provision of reproductive health services.

9. Key findings

Dual Strategy Imperative: The most significant correlation that was found is between Skilled Birth Attendance and Family Planning, where an increase in either variable leads to a decrease in Maternal Mortality. In order to attain SDG 3.1, policies should consider 3.1.2 and 3.7.1 as complementary strategic tools.

Geographical Inequality: The Filled Maps always demonstrate that nations located in Sub-Saharan Africa and Southern Asia are the most affected by maternal mortality and low rates of family planning and skilled birth attendance, which indicates that the most effective way to make a difference is by implementing regional-focused interventions.

Last Mile Gap: although there are general positive global developments since 2000, there are still a small but critical number of countries that are miles behind (e.g., 40 countries below 50% SBA). This leaving no one behind is the gap that is mainly seen in the fragile states and requires specific allocation of resources.

10. Impact of analysis and policy maker support

The interactive Power BI dashboard is a powerful, evidence-based tool that can work in a significant manner to assist policymakers and Non-Governmental Organisations (NGOs) to make evidence-based decisions, which will eventually speed up the SDG 3 implementation.

Ministries of Health in the countries where the company operates.

The dashboard enables real time monitoring and bench marking with peer nations and global targets (KPIs). The Country Comparison of Family Planning Coverage gives them an opportunity to establish high, yet achievable, national goals to accomplish and monitor the success of existing health initiatives. The correlation plots warrant combined budgets to finance the facility improvements (SBA) and commodity/outreach (Family Planning) at the same time.

Global Health Donors and NGOs.

The maps and KPI cards help to easily pinpoint areas and nations with the highest unmet points. The Dynamic KPIs will enable donors to specifically direct their funds to the 40 countries with poor SBA or the 22 countries with low Family Planning coverage to maximally affect the most vulnerable populations.

Academics and Researchers

The data is interactive, which is why it is easy to test the hypothesis quickly (e.g., how SBA and MMR correlate) and venture into the outlier performance, which will form the basis of further statistical or qualitative research.

11. Limitations

The analysis is quite informative, but it has the following limitations:

Timeliness of Data and Otherwise: According to the instructions, the data may not be the most current. There is also a tendency to have reporting lags in SDG data, and hence the latest effects of the policy changes might be obscured. Moreover, YoY change metrics can be compared on a global basis only to a certain extent because some countries might lack data points.

Aggregation Bias: The analysis is based on averages at levels of nations. This can obscure important sub-national inequalities including: between urban and rural zones, or amongst certain demographic groups (e.g. young women, non-mainstream populations), which Power BI would not be able to represent without even finer disaggregated data.

Correlation vs Causation: The scatter plots indicate that there is a strong correlation between high SBA/FP and low MMR, but Power BI will not give conclusive results that it is a causal relationship. Other external factors such as the national income, education of females, and quality of infrastructure are also critical and though not modelled play a critical role.

12. Recommendations

Resting on the most significant conclusions, the following recommendations could be offered to speed up the process of achieving SDG 3:

Implement an Integrated Health Policy: Policy frameworks and budgets need to be clearly formulated to reinforce both Skilled Birth Attendance (improving facility quality and staffing) and Family Planning Access (expanding rural outreach and access to modern contraceptives) based on the close correlation that is evident in the analysis.

Target High-Burden Geographies: The dashboard should be used by Donors and international organisations to prioritize their resource allocation of the countries and regions that are greatly off-track and is to be applied to both the Max MMR and the low-coverage areas identified by the maps.

Invest in Disaggregated Data: The future data collection needs to center on sub-national and demographic (age, income) collection of data on all SDG 3 indicators. This will enable the policymakers to monitor the progress of the "last mile" populations and indeed leave no one behind.

Encourage Digital-First Surveillance: National governments ought to embrace systems such as this Power BI dashboard to have real-time interactive surveillance. It moves the emphasis in the rigid reports into the dynamic and evidence based changes in policies, which fosters accountability and transparency.

13. Conclusion

This assignment was able to achieve the goal of Task 3 because it utilized advanced SQL Server and Power BI capability to manage, transform and analyse the complex global health data of the UN SDG repository with a particular focus on Targets 3.1 (Maternal Mortality and Skilled Birth Attendance) and 3.7 (Family Planning). It was done by taking raw data and incorporating it into a relational SQL database and then advanced data modelling in Power BI with the help of DAX to create time intelligence and metrics. The ensuing four page interactive dashboard effectively illustrated long-term trends, pointed at the existence of great geographical differences through filled maps and most importantly determined the strong reliance of the three indicators of health through correlation analysis.

The most important conclusions validated that although the global trend on maternal mortality reduction has been reached overall, there still exist deep and significant inequalities, through both the high burden in a relatively small number of countries and the difficulty of reaching low coverage in the last mile populations. As has been conclusively outlined in the analysis, a dual-pronged policy approach consisting of investing the same in the quality of facility-based maternal health services (Skilled Birth Attendance) and the availability of community-based reproductive health (Family Planning) is urgently required so as to make a maximum difference in the Maternal Mortality Ratio.

Finally, the achieved dashboard can be used as a very efficient and current business intelligence instrument. It enables policy makers and NGOs to go beyond the stagnant reports, allowing policy makers access to transform the raw and multi-dimensional data into evidence-based and actionable insights. The interactive filters, dynamic metrics, and visual evidence of correlation make the tool an essential resource in the process of driving specific resources allocation and encouraging responsible governance required to ensure that all countries meet the ambitious SDG 3 targets by 2030.