

# Covid - 19 Vaccine Analysis

|                     |                                    |
|---------------------|------------------------------------|
| <b>Project Name</b> | <b>Covid - 19 Vaccine Analysis</b> |
| <b>Team ID</b>      | <b>8934</b>                        |
| <b>Date</b>         | <b>01/11/2023</b>                  |

## Introduction:

In the age of information, data-driven decision-making is at the forefront of innovation across various industries. Applied Data Science, with its transformative capabilities, has emerged as a driving force for innovation, revolutionizing how organizations operate and solve complex problems.

The COVID-19 pandemic has made it crucial to thoroughly analyze vaccine data. This involves collecting data, exploring it, using it to make predictions, and making informed decisions. In this report, we'll discuss an innovative way to analyze COVID-19 vaccine data using Python and modern data science techniques.

Throughout this report, we'll go through each step of the process, showing how Python, advanced data visualization methods, and predictive modeling can help us make informed decisions that are vital in the global battle against COVID-19.

## Objective:

The goal of COVID-19 vaccine analysis is to understand how effective vaccines are at preventing the virus, identify areas that need more vaccinations, and make informed decisions to protect public health.

## **Problem Statement:**

The problem statement revolves around the analysis of COVID-19 vaccination data from various countries.

## **Design Thinking Process:**

1. **Understand:** Start by importing the required libraries and the dataset. Gain an initial understanding of the data by viewing its structure and a few sample records.
2. **Define:** Define the problem statement and the specific analysis goals, such as tracking vaccination progress, comparing countries, and identifying the impact of vaccines.
3. **Ideate:** Identify the necessary data preprocessing and analysis techniques. This includes handling missing data, transforming date formats, and using data visualization for insights.
4. **Prototype:** Create code to preprocess the data, perform the analysis, and generate visualizations.
5. **Test:** Check the data for consistency and verify the analysis results.

## **Phases of Development:**

### **1.Data Import and Initial Exploration:**

- Import the required libraries.
- Load the dataset ('country\_vaccinations.csv').
- Display the first few records to understand the data.

### **2.Data Preprocessing:**

- Handle missing data by replacing NaN values with zeros.
- Reset the index.
- Convert the 'date' column to a datetime format for ease of handling.

### **3.Data Analysis and Visualization:**

- Select specific countries (e.g., Bangladesh, India, China, Pakistan) for analysis.
- Analyze and visualize total and daily vaccinations for these countries.
- Compare vaccination efforts by plotting relevant graphs.

### **4.Comparative Analysis:**

- Group and sort countries by total vaccinations and vaccinations per 100 people.
- Generate bar plots to compare the top countries in terms of total vaccinations and vaccinations per 100 people.

### **5.Vaccine Comparison:**

- Create a bar plot to visualize the top vaccines used in different countries.

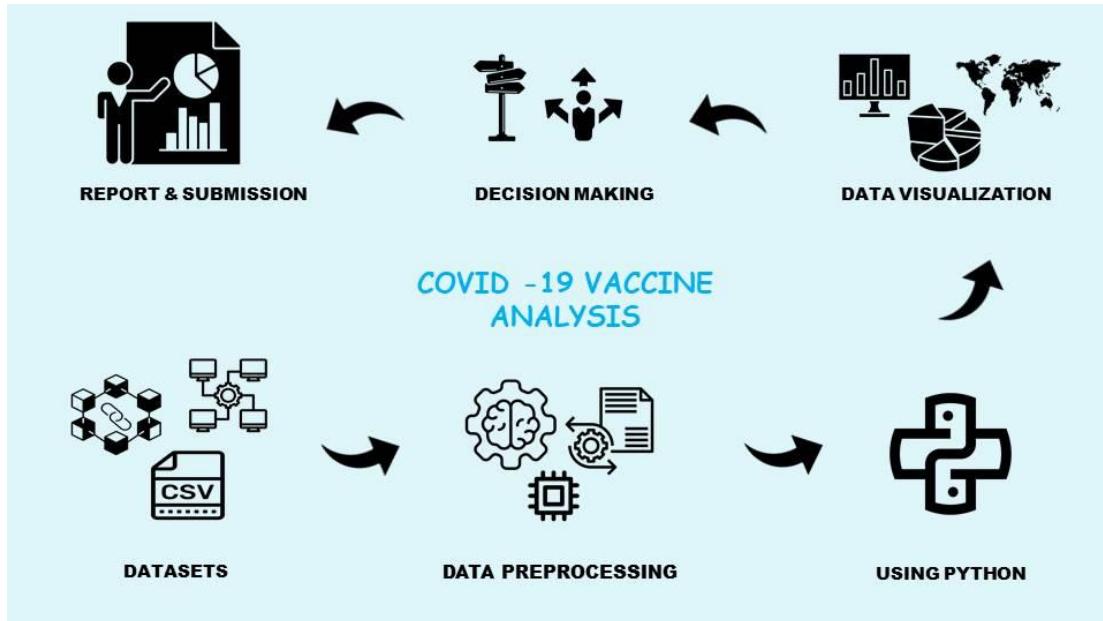
## **Key Findings, Insights, and Recommendations:**

- The analysis showed the progress of COVID-19 vaccinations in specific countries (Bangladesh, India, China, Pakistan).
- Total and daily vaccinations were visualized over time to track the vaccination efforts in these countries.
- Comparative analysis revealed the top countries in terms of total vaccinations and vaccinations per 100 people.
- The top vaccines used in different countries were identified and visualized.

**Based on the analysis,** the following recommendations can be made:

- Continuously monitor and improve vaccination efforts, especially in countries with lower vaccination rates.
- Share best practices and strategies among countries to accelerate vaccination campaigns.
- Maintain transparency and accessibility of vaccination data to ensure informed decision-making.

## Architecture Diagram:



1. Data Collection: COVID-19 datasets are gathered for analysis.
2. Data Preprocessing: Data is cleaned, transformed, and prepared for analysis using Python.
3. Data Exploration (EDA): Exploratory Data Analysis is performed to understand the data's characteristics and relationships.
4. Data Visualization: Python libraries are used to create meaningful visualizations for insights.
5. Predictive Modeling: Machine learning techniques are applied to build predictive models.
6. Decision-Making: Informed strategies and decisions are made based on the analysis and model outcomes.
7. Report Generation: Insights and outcomes are summarized in a comprehensive report.
8. Report Submission: The final report is submitted to stakeholders, guiding them in their response to the COVID-19 pandemic and vaccination efforts.

This architecture outlines the flow of COVID-19 vaccine analysis, starting from data collection and preprocessing, through data exploration and visualization, to predictive modeling, decision-making, report generation, and ultimately, report submission for informed actions and strategies.

## **Innovative Tools:**

- Jupyter Notebook
- NumPy
- Pandas
- Scikit-learn
- SciPy
- Matplotlib
- Plotly
- Seaborn

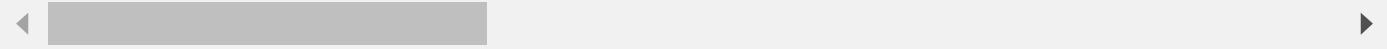
## **Conclusion:**

In the challenging landscape of the COVID-19 pandemic, the analysis of vaccine data has proven to be an indispensable tool. It has enabled us to understand the effectiveness of vaccines, identify areas where vaccinations are needed most, and make informed decisions. With the power of data science, Python, and innovative technologies, we've gained crucial insights that guide our response to the pandemic. As we continue this journey, data-driven analysis remains a cornerstone in our collective effort to combat COVID-19 and protect public health.

**Note:** We Submitted the project code below:

```
In [1]: #import the required Libraries  
#import the required dataset  
#view the dataset  
  
import pandas as pd  
import seaborn as sns  
import matplotlib.pyplot as plt  
import plotly.express as px  
%matplotlib inline  
df=pd.read_csv('Documents/country_vaccinations.csv')  
df.head()
```

```
Out[1]:    country iso_code   date  total_vaccinations  people_vaccinated  people_fully_vaccinated  daily_vac  
0  Afghanistan     AFG 2021-02-22             0.0                  0.0                      0.0                 NaN  
1  Afghanistan     AFG 2021-02-23            NaN                  NaN                      NaN                 NaN  
2  Afghanistan     AFG 2021-02-24            NaN                  NaN                      NaN                 NaN  
3  Afghanistan     AFG 2021-02-25            NaN                  NaN                      NaN                 NaN  
4  Afghanistan     AFG 2021-02-26            NaN                  NaN                      NaN                 NaN
```



```
In [3]: df1=df.dropna()  
print(df1)
```

|       | country                        | iso_code                            | date                   | total_vaccinations | \   |
|-------|--------------------------------|-------------------------------------|------------------------|--------------------|-----|
| 94    | Afghanistan                    | AFG                                 | 2021-05-27             | 593313.0           |     |
| 101   | Afghanistan                    | AFG                                 | 2021-06-03             | 630305.0           |     |
| 339   | Afghanistan                    | AFG                                 | 2022-01-27             | 5081064.0          |     |
| 433   | Albania                        | ALB                                 | 2021-02-18             | 3049.0             |     |
| 515   | Albania                        | ALB                                 | 2021-05-11             | 622507.0           |     |
| ...   | ...                            | ...                                 | ...                    | ...                | ... |
| 86507 | Zimbabwe                       | ZWE                                 | 2022-03-25             | 8691642.0          |     |
| 86508 | Zimbabwe                       | ZWE                                 | 2022-03-26             | 8791728.0          |     |
| 86509 | Zimbabwe                       | ZWE                                 | 2022-03-27             | 8845039.0          |     |
| 86510 | Zimbabwe                       | ZWE                                 | 2022-03-28             | 8934360.0          |     |
| 86511 | Zimbabwe                       | ZWE                                 | 2022-03-29             | 9039729.0          |     |
|       | people_vaccinated              | people_fully_vaccinated             | daily_vaccinations_raw | \                  |     |
| 94    | 479574.0                       | 113739.0                            | 2859.0                 |                    |     |
| 101   | 481800.0                       | 148505.0                            | 4015.0                 |                    |     |
| 339   | 4517380.0                      | 3868832.0                           | 6868.0                 |                    |     |
| 433   | 2438.0                         | 611.0                               | 1348.0                 |                    |     |
| 515   | 440921.0                       | 181586.0                            | 9548.0                 |                    |     |
| ...   | ...                            | ...                                 | ...                    | ...                | ... |
| 86507 | 4814582.0                      | 3473523.0                           | 139213.0               |                    |     |
| 86508 | 4886242.0                      | 3487962.0                           | 100086.0               |                    |     |
| 86509 | 4918147.0                      | 3493763.0                           | 53311.0                |                    |     |
| 86510 | 4975433.0                      | 3501493.0                           | 89321.0                |                    |     |
| 86511 | 5053114.0                      | 3510256.0                           | 105369.0               |                    |     |
|       | daily_vaccinations             | total_vaccinations_per_hundred      | \                      |                    |     |
| 94    | 6487.0                         | 1.49                                |                        |                    |     |
| 101   | 5285.0                         | 1.58                                |                        |                    |     |
| 339   | 9802.0                         | 12.76                               |                        |                    |     |
| 433   | 254.0                          | 0.11                                |                        |                    |     |
| 515   | 12160.0                        | 21.67                               |                        |                    |     |
| ...   | ...                            | ...                                 | ...                    | ...                | ... |
| 86507 | 69579.0                        | 57.59                               |                        |                    |     |
| 86508 | 83429.0                        | 58.25                               |                        |                    |     |
| 86509 | 90629.0                        | 58.61                               |                        |                    |     |
| 86510 | 100614.0                       | 59.20                               |                        |                    |     |
| 86511 | 103751.0                       | 59.90                               |                        |                    |     |
|       | people_vaccinated_per_hundred  | people_fully_vaccinated_per_hundred | \                      |                    |     |
| 94    | 1.20                           | 0.29                                |                        |                    |     |
| 101   | 1.21                           | 0.37                                |                        |                    |     |
| 339   | 11.34                          | 9.71                                |                        |                    |     |
| 433   | 0.08                           | 0.02                                |                        |                    |     |
| 515   | 15.35                          | 6.32                                |                        |                    |     |
| ...   | ...                            | ...                                 | ...                    | ...                | ... |
| 86507 | 31.90                          | 23.02                               |                        |                    |     |
| 86508 | 32.38                          | 23.11                               |                        |                    |     |
| 86509 | 32.59                          | 23.15                               |                        |                    |     |
| 86510 | 32.97                          | 23.20                               |                        |                    |     |
| 86511 | 33.48                          | 23.26                               |                        |                    |     |
|       | daily_vaccinations_per_million | \                                   |                        |                    |     |
| 94    | 163.0                          |                                     |                        |                    |     |
| 101   | 133.0                          |                                     |                        |                    |     |
| 339   | 246.0                          |                                     |                        |                    |     |
| 433   | 88.0                           |                                     |                        |                    |     |
| 515   | 4233.0                         |                                     |                        |                    |     |
| ...   | ...                            |                                     |                        |                    |     |
| 86507 | 4610.0                         |                                     |                        |                    |     |

```
86508          5528.0
86509          6005.0
86510          6667.0
86511          6874.0

                           vaccines \
94    Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
101   Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
339   Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
433   Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, ...
515   Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, ...
...
86507   Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86508   Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86509   Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86510   Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86511   Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...

                           source_name \
94    World Health Organization
101   World Health Organization
339   World Health Organization
433   Ministry of Health
515   Ministry of Health
...
86507   Ministry of Health
86508   Ministry of Health
86509   Ministry of Health
86510   Ministry of Health
86511   Ministry of Health

                           source_website
94                  https://covid19.who.int/
101                 https://covid19.who.int/
339                 https://covid19.who.int/
433   https://shendetesia.gov.al/vaksinimi-anticovid...
515   https://shendetesia.gov.al/vaksinimi-anticovid...
...
86507   https://www.arcgis.com/home/webmap/viewer.html...
86508   https://www.arcgis.com/home/webmap/viewer.html...
86509   https://www.arcgis.com/home/webmap/viewer.html...
86510   https://www.arcgis.com/home/webmap/viewer.html...
86511   https://www.arcgis.com/home/webmap/viewer.html...
```

[30847 rows x 15 columns]

```
In [3]: df1=df.reset_index()
print(df1)
```

|       | index                          | country                             | iso_code               | date       | total_vaccinations | \   |
|-------|--------------------------------|-------------------------------------|------------------------|------------|--------------------|-----|
| 0     | 0                              | Afghanistan                         | AFG                    | 2021-02-22 | 0.0                |     |
| 1     | 1                              | Afghanistan                         | AFG                    | 2021-02-23 | NaN                |     |
| 2     | 2                              | Afghanistan                         | AFG                    | 2021-02-24 | NaN                |     |
| 3     | 3                              | Afghanistan                         | AFG                    | 2021-02-25 | NaN                |     |
| 4     | 4                              | Afghanistan                         | AFG                    | 2021-02-26 | NaN                |     |
|       | ...                            | ...                                 | ...                    | ...        | ...                | ... |
| 86507 | 86507                          | Zimbabwe                            | ZWE                    | 2022-03-25 | 8691642.0          |     |
| 86508 | 86508                          | Zimbabwe                            | ZWE                    | 2022-03-26 | 8791728.0          |     |
| 86509 | 86509                          | Zimbabwe                            | ZWE                    | 2022-03-27 | 8845039.0          |     |
| 86510 | 86510                          | Zimbabwe                            | ZWE                    | 2022-03-28 | 8934360.0          |     |
| 86511 | 86511                          | Zimbabwe                            | ZWE                    | 2022-03-29 | 9039729.0          |     |
|       | people_vaccinated              | people_fully_vaccinated             | daily_vaccinations_raw | \          |                    |     |
| 0     | 0.0                            | NaN                                 | NaN                    | NaN        |                    |     |
| 1     | NaN                            | NaN                                 | NaN                    | NaN        |                    |     |
| 2     | NaN                            | NaN                                 | NaN                    | NaN        |                    |     |
| 3     | NaN                            | NaN                                 | NaN                    | NaN        |                    |     |
| 4     | NaN                            | NaN                                 | NaN                    | NaN        |                    |     |
|       | ...                            | ...                                 | ...                    | ...        | ...                | ... |
| 86507 | 4814582.0                      | 3473523.0                           | 3473523.0              | 139213.0   |                    |     |
| 86508 | 4886242.0                      | 3487962.0                           | 3487962.0              | 100086.0   |                    |     |
| 86509 | 4918147.0                      | 3493763.0                           | 3493763.0              | 53311.0    |                    |     |
| 86510 | 4975433.0                      | 3501493.0                           | 3501493.0              | 89321.0    |                    |     |
| 86511 | 5053114.0                      | 3510256.0                           | 3510256.0              | 105369.0   |                    |     |
|       | daily_vaccinations             | total_vaccinations_per_hundred      | \                      |            |                    |     |
| 0     | NaN                            | 0.00                                | 0.00                   |            |                    |     |
| 1     | 1367.0                         | NaN                                 | NaN                    |            |                    |     |
| 2     | 1367.0                         | NaN                                 | NaN                    |            |                    |     |
| 3     | 1367.0                         | NaN                                 | NaN                    |            |                    |     |
| 4     | 1367.0                         | NaN                                 | NaN                    |            |                    |     |
|       | ...                            | ...                                 | ...                    |            |                    |     |
| 86507 | 69579.0                        | 57.59                               | 57.59                  |            |                    |     |
| 86508 | 83429.0                        | 58.25                               | 58.25                  |            |                    |     |
| 86509 | 90629.0                        | 58.61                               | 58.61                  |            |                    |     |
| 86510 | 100614.0                       | 59.20                               | 59.20                  |            |                    |     |
| 86511 | 103751.0                       | 59.90                               | 59.90                  |            |                    |     |
|       | people_vaccinated_per_hundred  | people_fully_vaccinated_per_hundred | \                      |            |                    |     |
| 0     | 0.00                           | NaN                                 | NaN                    |            |                    |     |
| 1     | NaN                            | NaN                                 | NaN                    |            |                    |     |
| 2     | NaN                            | NaN                                 | NaN                    |            |                    |     |
| 3     | NaN                            | NaN                                 | NaN                    |            |                    |     |
| 4     | NaN                            | NaN                                 | NaN                    |            |                    |     |
|       | ...                            | ...                                 | ...                    |            |                    |     |
| 86507 | 31.90                          | 23.02                               | 23.02                  |            |                    |     |
| 86508 | 32.38                          | 23.11                               | 23.11                  |            |                    |     |
| 86509 | 32.59                          | 23.15                               | 23.15                  |            |                    |     |
| 86510 | 32.97                          | 23.20                               | 23.20                  |            |                    |     |
| 86511 | 33.48                          | 23.26                               | 23.26                  |            |                    |     |
|       | daily_vaccinations_per_million | \                                   |                        |            |                    |     |
| 0     | NaN                            |                                     |                        |            |                    |     |
| 1     | 34.0                           |                                     |                        |            |                    |     |
| 2     | 34.0                           |                                     |                        |            |                    |     |
| 3     | 34.0                           |                                     |                        |            |                    |     |
| 4     | 34.0                           |                                     |                        |            |                    |     |
|       | ...                            | ...                                 |                        |            |                    |     |
| 86507 | 4610.0                         |                                     |                        |            |                    |     |

```
86508          5528.0
86509          6005.0
86510          6667.0
86511          6874.0

                           vaccines \
0    Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
1    Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
2    Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
3    Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
4    Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
...
86507  Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86508  Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86509  Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86510  Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86511  Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...

                           source_name \
0    World Health Organization
1    World Health Organization
2    World Health Organization
3    World Health Organization
4    World Health Organization
...
86507      Ministry of Health
86508      Ministry of Health
86509      Ministry of Health
86510      Ministry of Health
86511      Ministry of Health

                           source_website
0                  https://covid19.who.int/
1                  https://covid19.who.int/
2                  https://covid19.who.int/
3                  https://covid19.who.int/
4                  https://covid19.who.int/
...
86507  https://www.arcgis.com/home/webmap/viewer.html...
86508  https://www.arcgis.com/home/webmap/viewer.html...
86509  https://www.arcgis.com/home/webmap/viewer.html...
86510  https://www.arcgis.com/home/webmap/viewer.html...
86511  https://www.arcgis.com/home/webmap/viewer.html...
```

[86512 rows x 16 columns]

In [5]: df.info()

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 86512 entries, 0 to 86511
Data columns (total 15 columns):
 #   Column           Non-Null Count  Dtype  
--- 
 0   country          86512 non-null   object  
 1   iso_code          86512 non-null   object  
 2   date              86512 non-null   object  
 3   total_vaccinations 43607 non-null   float64 
 4   people_vaccinated 41294 non-null   float64 
 5   people_fully_vaccinated 38802 non-null   float64 
 6   daily_vaccinations_raw 35362 non-null   float64 
 7   daily_vaccinations 86213 non-null   float64 
 8   total_vaccinations_per_hundred 43607 non-null   float64 
 9   people_vaccinated_per_hundred 41294 non-null   float64 
 10  people_fully_vaccinated_per_hundred 38802 non-null   float64 
 11  daily_vaccinations_per_million 86213 non-null   float64 
 12  vaccines          86512 non-null   object  
 13  source_name        86512 non-null   object  
 14  source_website     86512 non-null   object  
dtypes: float64(9), object(6)
memory usage: 9.9+ MB
```

In [2]: `df.describe()`

Out[2]:

|              | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily_vaccinations_raw | daily_vacc |
|--------------|--------------------|-------------------|-------------------------|------------------------|------------|
| <b>count</b> | 4.360700e+04       | 4.129400e+04      | 3.880200e+04            | 3.536200e+04           | 8.621      |
| <b>mean</b>  | 4.592964e+07       | 1.770508e+07      | 1.413830e+07            | 2.705996e+05           | 1.313      |
| <b>std</b>   | 2.246004e+08       | 7.078731e+07      | 5.713920e+07            | 1.212427e+06           | 7.682      |
| <b>min</b>   | 0.000000e+00       | 0.000000e+00      | 1.000000e+00            | 0.000000e+00           | 0.000      |
| <b>25%</b>   | 5.264100e+05       | 3.494642e+05      | 2.439622e+05            | 4.668000e+03           | 9.000      |
| <b>50%</b>   | 3.590096e+06       | 2.187310e+06      | 1.722140e+06            | 2.530900e+04           | 7.343      |
| <b>75%</b>   | 1.701230e+07       | 9.152520e+06      | 7.559870e+06            | 1.234925e+05           | 4.409      |
| <b>max</b>   | 3.263129e+09       | 1.275541e+09      | 1.240777e+09            | 2.474100e+07           | 2.242      |

In [3]: `df.isnull().sum()`

```
Out[3]: country          0
         iso_code        0
         date            0
         total_vaccinations 42905
         people_vaccinated 45218
         people_fully_vaccinated 47710
         daily_vaccinations_raw 51150
         daily_vaccinations      299
         total_vaccinations_per_hundred 42905
         people_vaccinated_per_hundred 45218
         people_fully_vaccinated_per_hundred 47710
         daily_vaccinations_per_million 299
         vaccines           0
         source_name         0
         source_website       0
         dtype: int64
```

```
In [6]: df.fillna(0, inplace = True)
df.drop(df.index[df['iso_code'] == 0], inplace = True)
```

```
In [5]: df.isnull().sum()
```

```
Out[5]: country          0
         iso_code        0
         date            0
         total_vaccinations 0
         people_vaccinated 0
         people_fully_vaccinated 0
         daily_vaccinations_raw 0
         daily_vaccinations      0
         total_vaccinations_per_hundred 0
         people_vaccinated_per_hundred 0
         people_fully_vaccinated_per_hundred 0
         daily_vaccinations_per_million 0
         vaccines           0
         source_name         0
         source_website       0
         dtype: int64
```

```
In [6]: #The date is in the 'object' format. Let us change it to Datetime format for easy handling
df['date'] = pd.to_datetime(df['date'], format='%Y-%m-%d')
```

```
In [7]: df.columns
```

```
Out[7]: Index(['country', 'iso_code', 'date', 'total_vaccinations',
       'people_vaccinated', 'people_fully_vaccinated',
       'daily_vaccinations_raw', 'daily_vaccinations',
       'total_vaccinations_per_hundred', 'people_vaccinated_per_hundred',
       'people_fully_vaccinated_per_hundred', 'daily_vaccinations_per_million',
       'vaccines', 'source_name', 'source_website'],
      dtype='object')
```

```
In [12]: df.drop(["people_fully_vaccinated","daily_vaccinations_raw","people_vaccinated_per_hundred",
       "people_fully_vaccinated_per_hundred","daily_vaccinations_per_million","source_
```

Out[12]:

|       | country     | iso_code | date       | total_vaccinations | people_vaccinated | daily_vaccinations | total_vac |
|-------|-------------|----------|------------|--------------------|-------------------|--------------------|-----------|
| 0     | Afghanistan | AFG      | 2021-02-22 | 0.0                | 0.0               | 0.0                | 0.0       |
| 1     | Afghanistan | AFG      | 2021-02-23 | 0.0                | 0.0               | 1367.0             |           |
| 2     | Afghanistan | AFG      | 2021-02-24 | 0.0                | 0.0               | 1367.0             |           |
| 3     | Afghanistan | AFG      | 2021-02-25 | 0.0                | 0.0               | 1367.0             |           |
| 4     | Afghanistan | AFG      | 2021-02-26 | 0.0                | 0.0               | 1367.0             |           |
| ...   | ...         | ...      | ...        | ...                | ...               | ...                | ...       |
| 86507 | Zimbabwe    | ZWE      | 2022-03-25 | 8691642.0          | 4814582.0         | 69579.0            |           |
| 86508 | Zimbabwe    | ZWE      | 2022-03-26 | 8791728.0          | 4886242.0         | 83429.0            |           |
| 86509 | Zimbabwe    | ZWE      | 2022-03-27 | 8845039.0          | 4918147.0         | 90629.0            |           |
| 86510 | Zimbabwe    | ZWE      | 2022-03-28 | 8934360.0          | 4975433.0         | 100614.0           |           |
| 86511 | Zimbabwe    | ZWE      | 2022-03-29 | 9039729.0          | 5053114.0         | 103751.0           |           |

86512 rows × 8 columns



In [15]:

```
#BANGLADESH
df_BGD = df[df["iso_code"] == 'BGD'].copy()
df_BGD
```

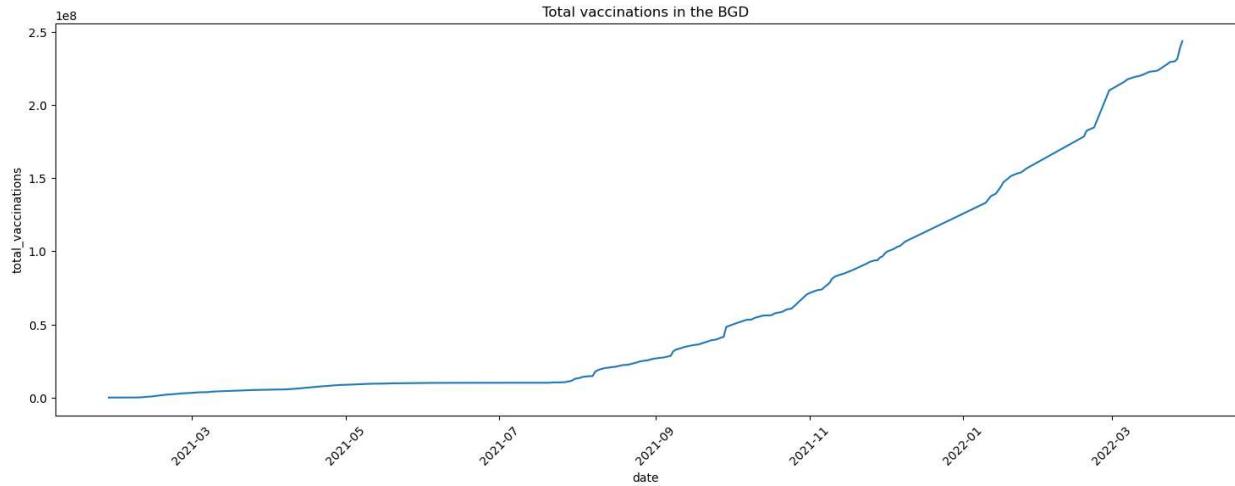
Out[15]:

|      | country    | iso_code | date       | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily |
|------|------------|----------|------------|--------------------|-------------------|-------------------------|-------|
| 6133 | Bangladesh | BGD      | 2021-01-26 | 0.0                | 0.0               | 0.0                     | 0.0   |
| 6134 | Bangladesh | BGD      | 2021-01-27 | 26.0               | 26.0              | 26.0                    | 0.0   |
| 6135 | Bangladesh | BGD      | 2021-01-28 | 567.0              | 567.0             | 567.0                   | 0.0   |
| 6136 | Bangladesh | BGD      | 2021-01-29 | 0.0                | 0.0               | 0.0                     | 0.0   |
| 6137 | Bangladesh | BGD      | 2021-01-30 | 0.0                | 0.0               | 0.0                     | 0.0   |
| ...  | ...        | ...      | ...        | ...                | ...               | ...                     | ...   |
| 6556 | Bangladesh | BGD      | 2022-03-25 | 0.0                | 0.0               | 0.0                     | 0.0   |
| 6557 | Bangladesh | BGD      | 2022-03-26 | 229789298.0        | 127084404.0       | 95424031.0              |       |
| 6558 | Bangladesh | BGD      | 2022-03-27 | 231420654.0        | 127169172.0       | 96671169.0              |       |
| 6559 | Bangladesh | BGD      | 2022-03-28 | 238459012.0        | 127365973.0       | 103130478.0             |       |
| 6560 | Bangladesh | BGD      | 2022-03-29 | 243642749.0        | 127544055.0       | 107712737.0             |       |

428 rows × 15 columns

In [16]: #Drop the dates with missing values, previously NaN that we filled with 0.  
df\_BGD.drop(df\_BGD.index[df\_BGD['total\_vaccinations'] == 0], inplace = True)

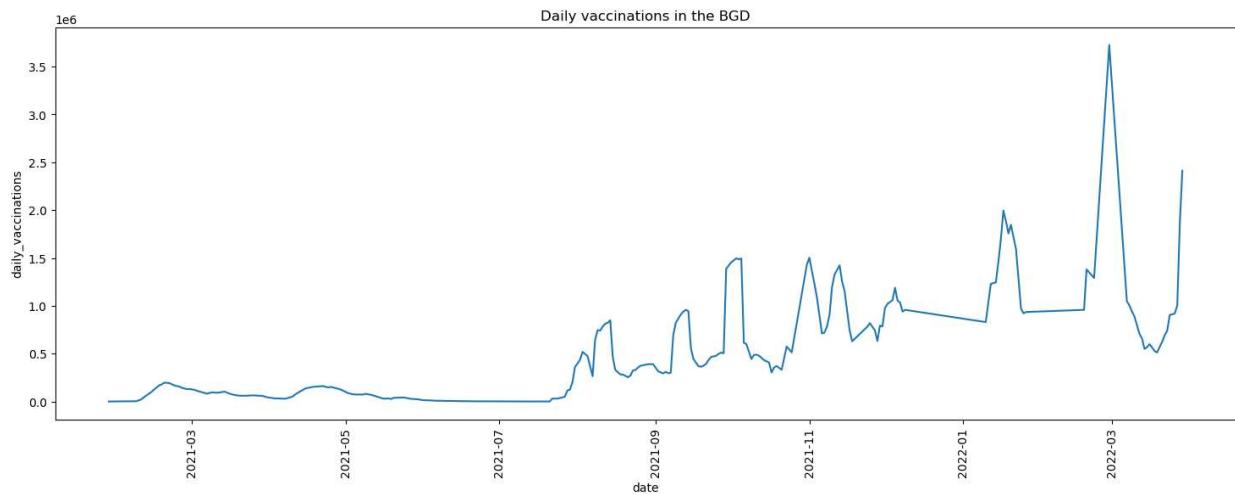
```
In [19]: #Plot total vaccinations as a function of date
plt.figure(figsize=(18,6))
sns.lineplot(data=df_BGD, x="date", y="total_vaccinations")
plt.title("Total vaccinations in the BGD")
plt.xticks(rotation=45)
plt.show()
```



```
In [20]: #Plot daily vaccinations as a function of date
plt.figure(figsize=(18,6))
sns.lineplot(data=df_BGD, x="date", y="daily_vaccinations")

plt.xticks(rotation=90)
plt.title("Daily vaccinations in the BGD")
```

Out[20]: Text(0.5, 1.0, 'Daily vaccinations in the BGD')



```
In [35]: #INDIA
df_IND = df[df["iso_code"] == 'IND'].copy()
df_IND=df_IND.head(10)
df_IND
```

Out[35]:

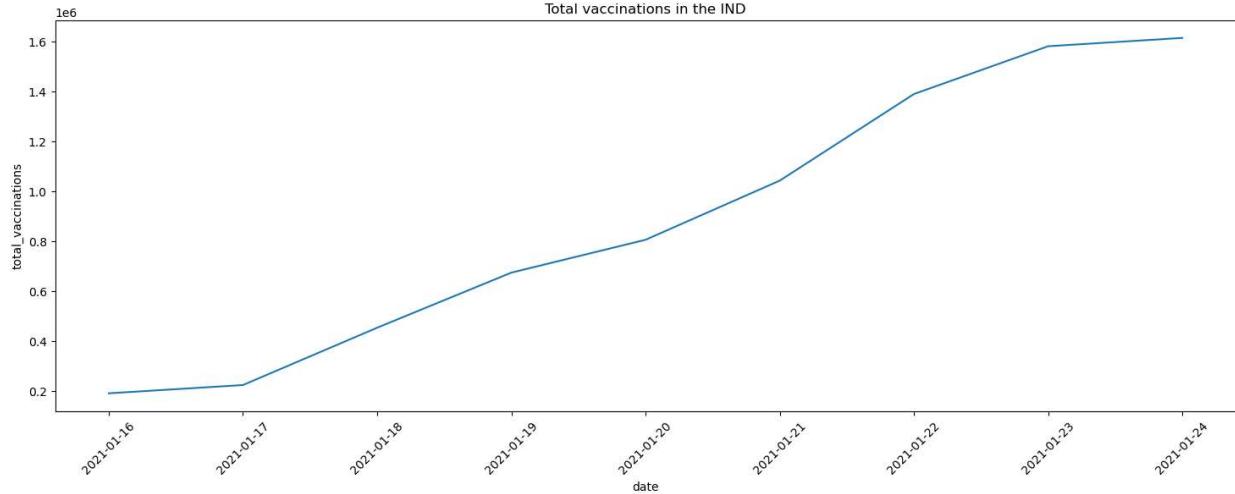
|       | country | iso_code | date       | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily_vaccinations |
|-------|---------|----------|------------|--------------------|-------------------|-------------------------|--------------------|
| 35372 | India   | IND      | 2021-01-15 | 0.0                | 0.0               | 0.0                     | NaN                |
| 35373 | India   | IND      | 2021-01-16 | 191181.0           | 191181.0          | 191181.0                | NaN                |
| 35374 | India   | IND      | 2021-01-17 | 224301.0           | 224301.0          | 224301.0                | NaN                |
| 35375 | India   | IND      | 2021-01-18 | 454049.0           | 454049.0          | 454049.0                | NaN                |
| 35376 | India   | IND      | 2021-01-19 | 674835.0           | 674835.0          | 674835.0                | NaN                |
| 35377 | India   | IND      | 2021-01-20 | 806484.0           | 806484.0          | 806484.0                | NaN                |
| 35378 | India   | IND      | 2021-01-21 | 1043534.0          | 1043534.0         | 1043534.0               | NaN                |
| 35379 | India   | IND      | 2021-01-22 | 1390592.0          | 1390592.0         | 1390592.0               | NaN                |
| 35380 | India   | IND      | 2021-01-23 | 1582201.0          | 1582201.0         | 1582201.0               | NaN                |
| 35381 | India   | IND      | 2021-01-24 | 1615504.0          | 1615504.0         | 1615504.0               | NaN                |

In [36]:

```
#Drop the dates with missing values, previously NaN that we filled with 0.
df_IND.drop(df_IND.index[df_IND['total_vaccinations'] == 0], inplace = True)
```

In [37]:

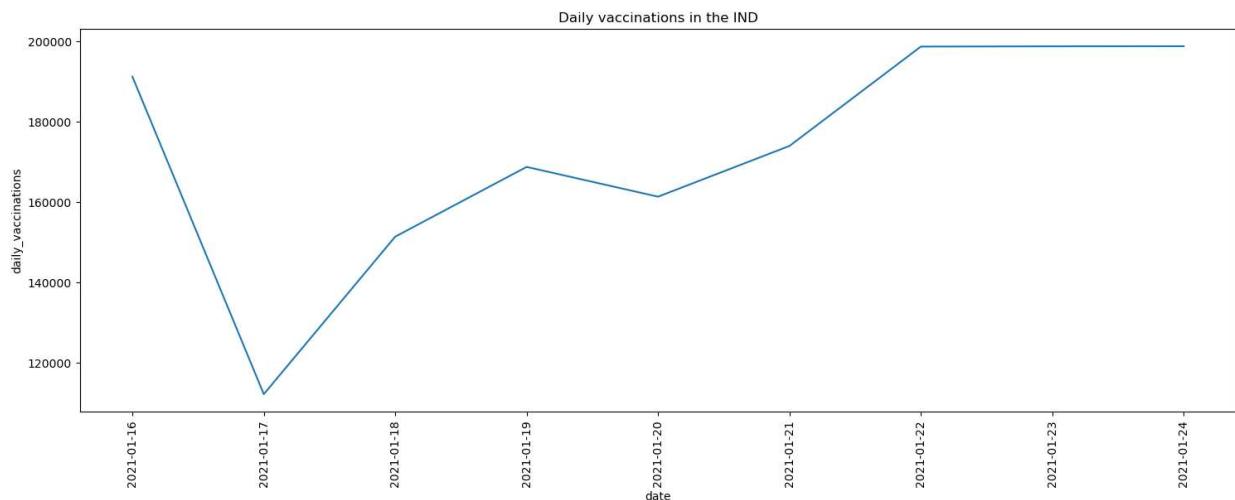
```
#Plot total vaccinations as a function of date
plt.figure(figsize=(18,6))
sns.lineplot(data=df_IND, x="date", y="total_vaccinations")
plt.title("Total vaccinations in the IND")
plt.xticks(rotation=45)
plt.show()
```



```
In [38]: #Plot daily vaccinations as a function of date
plt.figure(figsize=(18,6))
sns.lineplot(data=df_IND, x="date", y="daily_vaccinations")

plt.xticks(rotation=90)
plt.title("Daily vaccinations in the IND")
```

Out[38]: Text(0.5, 1.0, 'Daily vaccinations in the IND')



```
In [42]: #CHINA
df_CHN = df[df["iso_code"] == 'CHN'].copy()
df_CHN=df_CHN.head(20)
df_CHN
```

Out[42]:

|       |       | country | iso_code   | date | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily_vaccinations |
|-------|-------|---------|------------|------|--------------------|-------------------|-------------------------|--------------------|
| 15756 | China | CHN     | 2020-12-15 |      | 1500000.0          | NaN               | NaN                     | NaN                |
| 15757 | China | CHN     | 2020-12-16 |      | NaN                | NaN               | NaN                     | NaN                |
| 15758 | China | CHN     | 2020-12-17 |      | NaN                | NaN               | NaN                     | NaN                |
| 15759 | China | CHN     | 2020-12-18 |      | NaN                | NaN               | NaN                     | NaN                |
| 15760 | China | CHN     | 2020-12-19 |      | NaN                | NaN               | NaN                     | NaN                |
| 15761 | China | CHN     | 2020-12-20 |      | NaN                | NaN               | NaN                     | NaN                |
| 15762 | China | CHN     | 2020-12-21 |      | NaN                | NaN               | NaN                     | NaN                |
| 15763 | China | CHN     | 2020-12-22 |      | NaN                | NaN               | NaN                     | NaN                |
| 15764 | China | CHN     | 2020-12-23 |      | NaN                | NaN               | NaN                     | NaN                |
| 15765 | China | CHN     | 2020-12-24 |      | NaN                | NaN               | NaN                     | NaN                |
| 15766 | China | CHN     | 2020-12-25 |      | NaN                | NaN               | NaN                     | NaN                |
| 15767 | China | CHN     | 2020-12-26 |      | NaN                | NaN               | NaN                     | NaN                |
| 15768 | China | CHN     | 2020-12-27 |      | NaN                | NaN               | NaN                     | NaN                |

| country | iso_code | date | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily_vaccinations |
|---------|----------|------|--------------------|-------------------|-------------------------|--------------------|
|---------|----------|------|--------------------|-------------------|-------------------------|--------------------|

|       |       |     |            |     |     |     |
|-------|-------|-----|------------|-----|-----|-----|
| 15769 | China | CHN | 2020-12-28 | NaN | NaN | NaN |
|-------|-------|-----|------------|-----|-----|-----|

|       |       |     |            |     |     |     |
|-------|-------|-----|------------|-----|-----|-----|
| 15770 | China | CHN | 2020-12-29 | NaN | NaN | NaN |
|-------|-------|-----|------------|-----|-----|-----|

|       |       |     |            |     |     |     |
|-------|-------|-----|------------|-----|-----|-----|
| 15771 | China | CHN | 2020-12-30 | NaN | NaN | NaN |
|-------|-------|-----|------------|-----|-----|-----|

|       |       |     |            |           |     |     |
|-------|-------|-----|------------|-----------|-----|-----|
| 15772 | China | CHN | 2020-12-31 | 4500000.0 | NaN | NaN |
|-------|-------|-----|------------|-----------|-----|-----|

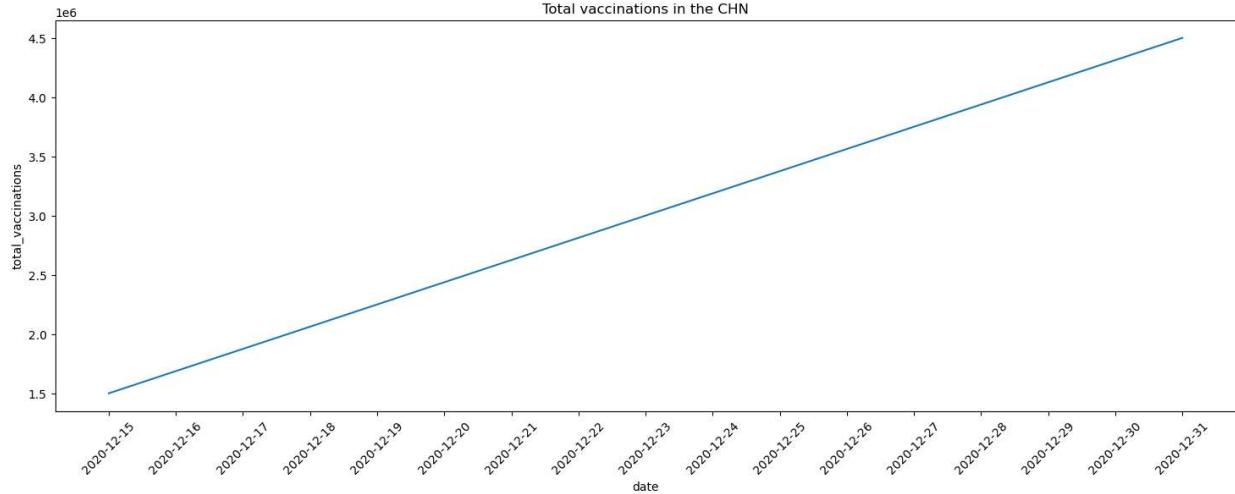
|       |       |     |            |     |     |     |
|-------|-------|-----|------------|-----|-----|-----|
| 15773 | China | CHN | 2021-01-01 | NaN | NaN | NaN |
|-------|-------|-----|------------|-----|-----|-----|

|       |       |     |            |     |     |     |
|-------|-------|-----|------------|-----|-----|-----|
| 15774 | China | CHN | 2021-01-02 | NaN | NaN | NaN |
|-------|-------|-----|------------|-----|-----|-----|

|       |       |     |            |     |     |     |
|-------|-------|-----|------------|-----|-----|-----|
| 15775 | China | CHN | 2021-01-03 | NaN | NaN | NaN |
|-------|-------|-----|------------|-----|-----|-----|

In [43]: `#Drop the dates with missing values, previously NaN that we filled with 0.  
df_CHN.drop(df_CHN.index[df_CHN['total_vaccinations'] == 0], inplace = True)`

In [44]: `#Plot total vaccinations as a function of date  
plt.figure(figsize=(18,6))  
sns.lineplot(data=df_CHN, x="date", y="total_vaccinations")  
plt.title("Total vaccinations in the CHN")  
plt.xticks(rotation=45)  
plt.show()`

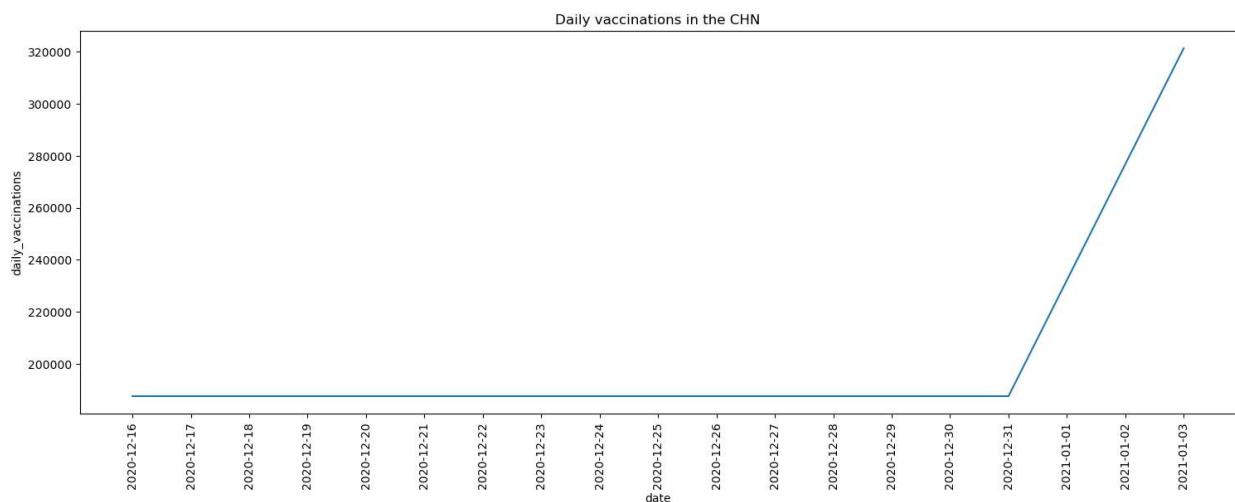


In [45]: *#Plot daily vaccinations as a function of date*

```
plt.figure(figsize=(18,6))
sns.lineplot(data=df_CHN, x="date", y="daily_vaccinations")

plt.xticks(rotation=90)
plt.title("Daily vaccinations in the CHN")
```

Out[45]:



In [49]: *#PAKISTAN*

```
df_PAK = df[df["iso_code"] == 'PAK'].copy()
df_PAK=df_PAK.head(20)
df_PAK
```

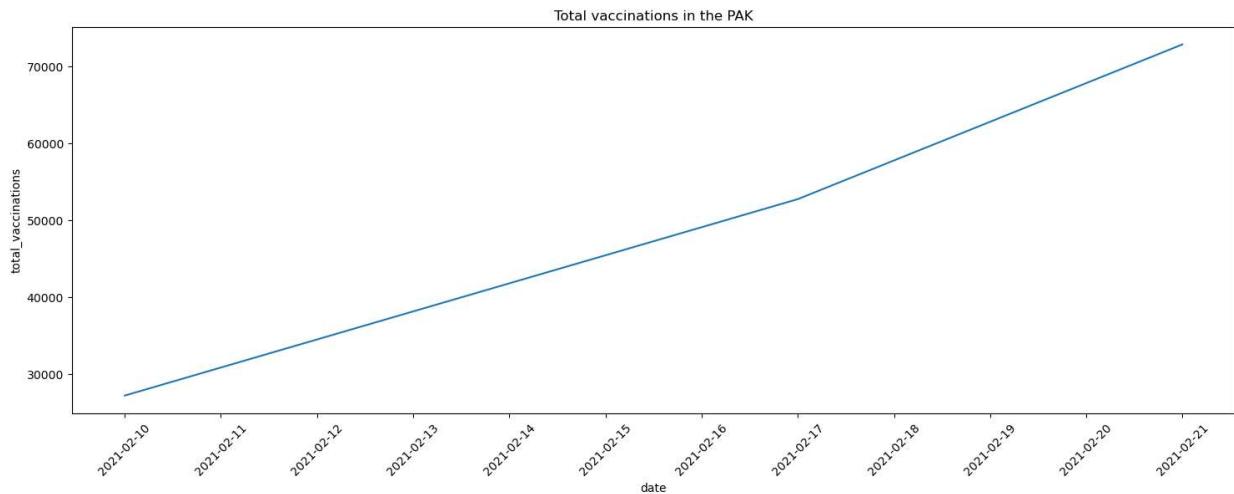
Out[49]:

|       | country  | iso_code | date       | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily_vaccinations |
|-------|----------|----------|------------|--------------------|-------------------|-------------------------|--------------------|
| 59449 | Pakistan | PAK      | 2021-02-02 | 0.0                | 0.0               |                         | NaN                |
| 59450 | Pakistan | PAK      | 2021-02-03 | NaN                | NaN               |                         | NaN                |
| 59451 | Pakistan | PAK      | 2021-02-04 | NaN                | NaN               |                         | NaN                |
| 59452 | Pakistan | PAK      | 2021-02-05 | NaN                | NaN               |                         | NaN                |
| 59453 | Pakistan | PAK      | 2021-02-06 | NaN                | NaN               |                         | NaN                |
| 59454 | Pakistan | PAK      | 2021-02-07 | NaN                | NaN               |                         | NaN                |
| 59455 | Pakistan | PAK      | 2021-02-08 | NaN                | NaN               |                         | NaN                |
| 59456 | Pakistan | PAK      | 2021-02-09 | NaN                | NaN               |                         | NaN                |
| 59457 | Pakistan | PAK      | 2021-02-10 | 27228.0            | 27228.0           |                         | NaN                |
| 59458 | Pakistan | PAK      | 2021-02-11 | NaN                | NaN               |                         | NaN                |

|       | country  | iso_code | date       | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily_vaccinations |
|-------|----------|----------|------------|--------------------|-------------------|-------------------------|--------------------|
| 59459 | Pakistan | PAK      | 2021-02-12 | NaN                | NaN               | NaN                     | NaN                |
| 59460 | Pakistan | PAK      | 2021-02-13 | NaN                | NaN               | NaN                     | NaN                |
| 59461 | Pakistan | PAK      | 2021-02-14 | NaN                | NaN               | NaN                     | NaN                |
| 59462 | Pakistan | PAK      | 2021-02-15 | NaN                | NaN               | NaN                     | NaN                |
| 59463 | Pakistan | PAK      | 2021-02-16 | NaN                | NaN               | NaN                     | NaN                |
| 59464 | Pakistan | PAK      | 2021-02-17 | 52768.0            | 52768.0           | 52768.0                 | NaN                |
| 59465 | Pakistan | PAK      | 2021-02-18 | NaN                | NaN               | NaN                     | NaN                |
| 59466 | Pakistan | PAK      | 2021-02-19 | NaN                | NaN               | NaN                     | NaN                |
| 59467 | Pakistan | PAK      | 2021-02-20 | NaN                | NaN               | NaN                     | NaN                |
| 59468 | Pakistan | PAK      | 2021-02-21 | 72882.0            | 72882.0           | 72882.0                 | NaN                |

```
In [50]: #Drop the dates with missing values, previously NaN that we filled with 0.
df_PAK.drop(df_PAK.index[df_PAK['total_vaccinations'] == 0], inplace = True)
```

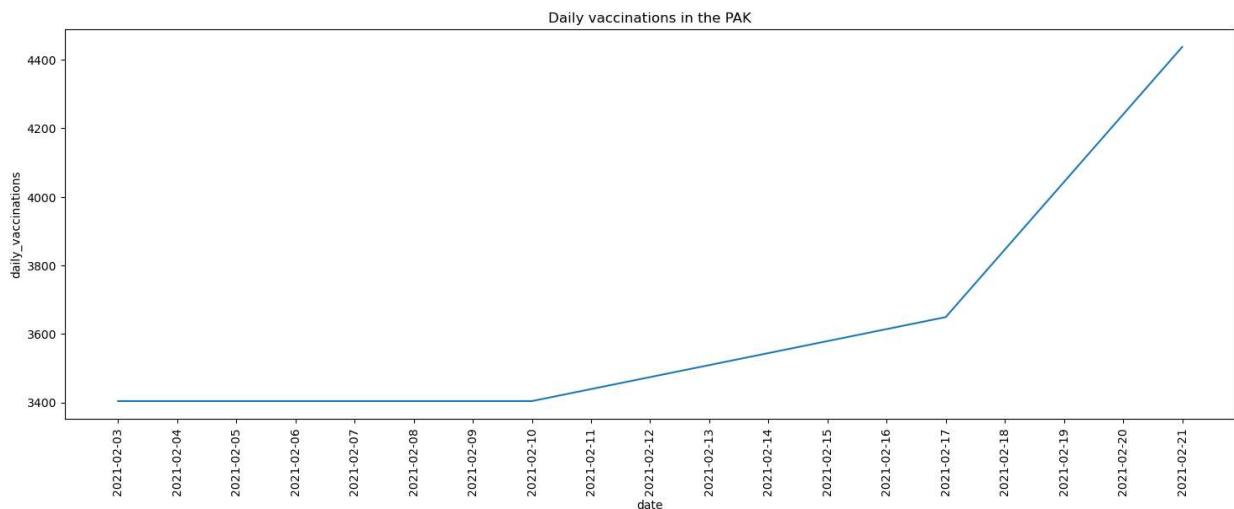
```
In [51]: #Plot total vaccinations as a function of date
plt.figure(figsize=(18,6))
sns.lineplot(data=df_PAK, x="date", y="total_vaccinations")
plt.title("Total vaccinations in the PAK")
plt.xticks(rotation=45)
plt.show()
```



```
In [52]: #Plot daily vaccinations as a function of date
plt.figure(figsize=(18,6))
sns.lineplot(data=df_PAK, x="date", y="daily_vaccinations")

plt.xticks(rotation=90)
plt.title("Daily vaccinations in the PAK")
```

Out[52]: Text(0.5, 1.0, 'Daily vaccinations in the PAK')



```
In [53]: #Group by total vaccinations given by country and sort descending to identify the top
vacc_by_country = df.groupby('country').max().sort_values('total_vaccinations', ascending=False)
vacc_by_country = vacc_by_country.iloc[:10]
vacc_by_country
```

Out[53]:

|                | iso_code | date | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily_vacci |
|----------------|----------|------|--------------------|-------------------|-------------------------|-------------|
| <b>country</b> |          |      |                    |                   |                         |             |

|                      |     |            |              |              |              |  |
|----------------------|-----|------------|--------------|--------------|--------------|--|
| <b>country</b>       |     |            |              |              |              |  |
| <b>China</b>         | CHN | 2022-03-29 | 3.263129e+09 | 1.275541e+09 | 1.240777e+09 |  |
| <b>India</b>         | IND | 2022-03-29 | 1.834501e+09 | 9.848381e+08 | 8.282295e+08 |  |
| <b>United States</b> | USA | 2022-03-28 | 5.601818e+08 | 2.553624e+08 | 2.174990e+08 |  |
| <b>Brazil</b>        | BRA | 2022-03-29 | 4.135596e+08 | 1.810781e+08 | 1.602729e+08 |  |
| <b>Indonesia</b>     | IDN | 2022-03-29 | 3.771089e+08 | 1.962409e+08 | 1.588305e+08 |  |
| <b>Japan</b>         | JPN | 2022-03-29 | 2.543456e+08 | 1.024675e+08 | 1.006337e+08 |  |
| <b>Bangladesh</b>    | BGD | 2022-03-29 | 2.436427e+08 | 1.275441e+08 | 1.077127e+08 |  |
| <b>Pakistan</b>      | PAK | 2022-03-10 | 2.193686e+08 | 1.280741e+08 | 1.018812e+08 |  |
| <b>Vietnam</b>       | VNM | 2022-03-22 | 2.031444e+08 | 7.994719e+07 | 7.775411e+07 |  |
| <b>Mexico</b>        | MEX | 2022-03-29 | 1.919079e+08 | 8.558029e+07 | 7.971176e+07 |  |

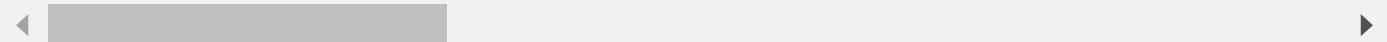
&lt; In [54]:

```
#Now sort by total vaccinations per 100
vacc_by_country = vacc_by_country.sort_values('total_vaccinations_per_hundred', ascending=False)
```



Out[54]:

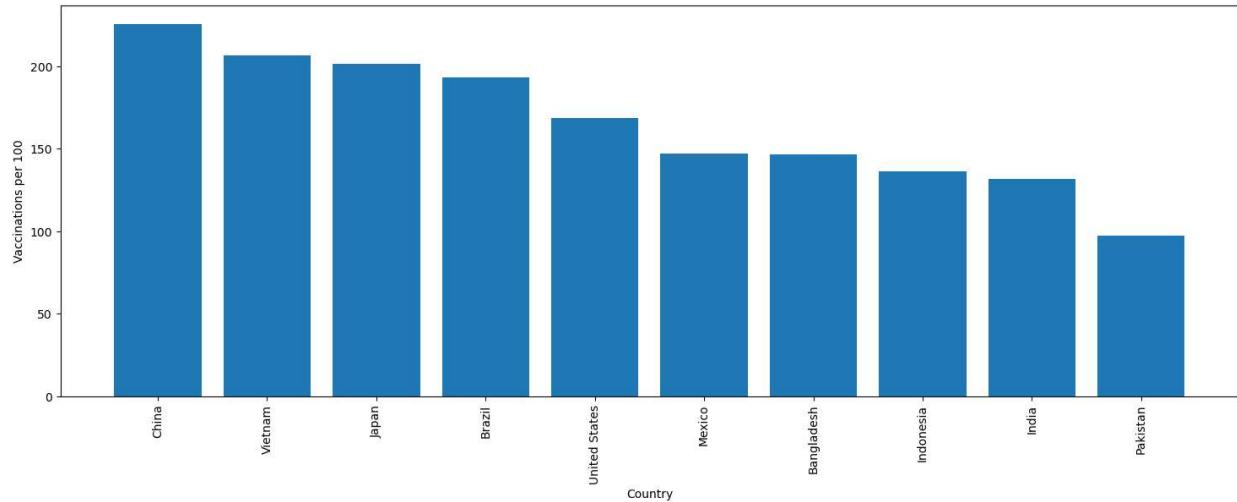
| country              | iso_code | date       | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily_vacci  |
|----------------------|----------|------------|--------------------|-------------------|-------------------------|--------------|
| <b>China</b>         | CHN      | 2022-03-29 | 3.263129e+09       | 1.275541e+09      |                         | 1.240777e+09 |
| <b>Vietnam</b>       | VNM      | 2022-03-22 | 2.031444e+08       | 7.994719e+07      |                         | 7.775411e+07 |
| <b>Japan</b>         | JPN      | 2022-03-29 | 2.543456e+08       | 1.024675e+08      |                         | 1.006337e+08 |
| <b>Brazil</b>        | BRA      | 2022-03-29 | 4.135596e+08       | 1.810781e+08      |                         | 1.602729e+08 |
| <b>United States</b> | USA      | 2022-03-28 | 5.601818e+08       | 2.553624e+08      |                         | 2.174990e+08 |
| <b>Mexico</b>        | MEX      | 2022-03-29 | 1.919079e+08       | 8.558029e+07      |                         | 7.971176e+07 |
| <b>Bangladesh</b>    | BGD      | 2022-03-29 | 2.436427e+08       | 1.275441e+08      |                         | 1.077127e+08 |
| <b>Indonesia</b>     | IDN      | 2022-03-29 | 3.771089e+08       | 1.962409e+08      |                         | 1.588305e+08 |
| <b>India</b>         | IND      | 2022-03-29 | 1.834501e+09       | 9.848381e+08      |                         | 8.282295e+08 |
| <b>Pakistan</b>      | PAK      | 2022-03-10 | 2.193686e+08       | 1.280741e+08      |                         | 1.018812e+08 |



In [55]:

```
plt.figure(figsize=(18, 6))
plt.bar(vacc_by_country.index, vacc_by_country.total_vaccinations_per_hundred)

plt.xticks(rotation = 90)
plt.ylabel('Vaccinations per 100')
plt.xlabel('Country')
plt.show()
```



```
In [56]: total_vacc_by_country = df.groupby('country').max().sort_values('total_vaccinations', ascending=False).iloc[:10]
```

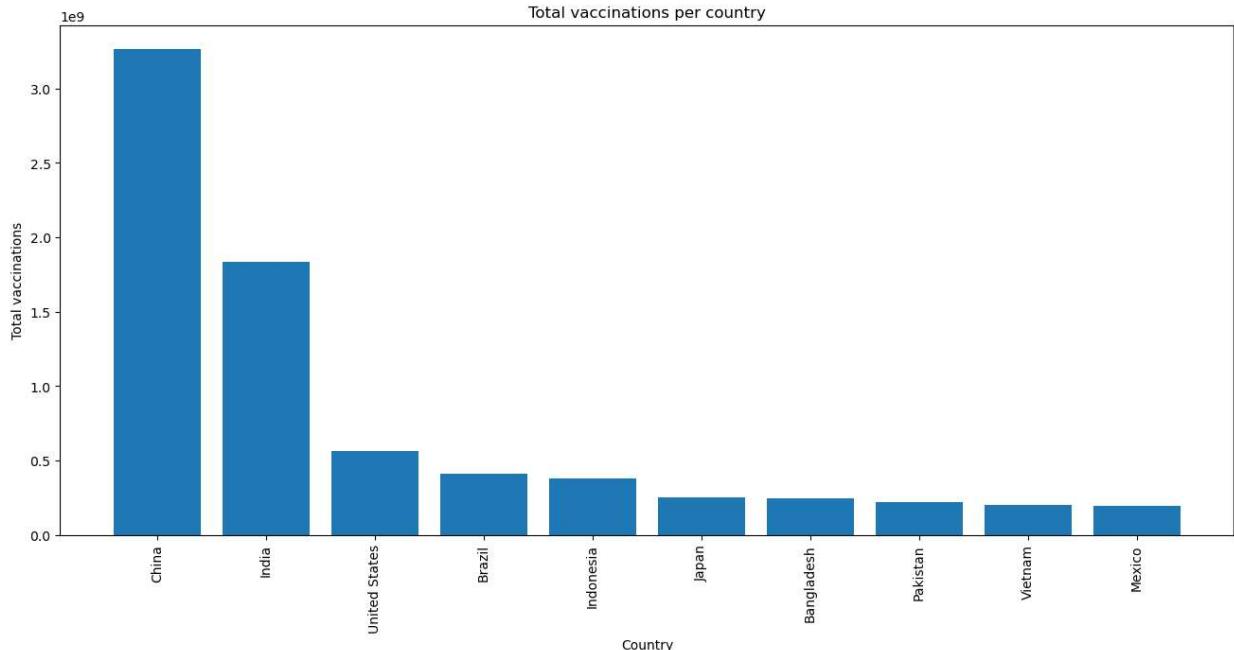
Out[56]:

|                      | iso_code | date       | total_vaccinations | people_vaccinated | people_fully_vaccinated | daily_vacci  |
|----------------------|----------|------------|--------------------|-------------------|-------------------------|--------------|
| country              |          |            |                    |                   |                         |              |
| <b>China</b>         | CHN      | 2022-03-29 | 3.263129e+09       | 1.275541e+09      |                         | 1.240777e+09 |
| <b>India</b>         | IND      | 2022-03-29 | 1.834501e+09       | 9.848381e+08      |                         | 8.282295e+08 |
| <b>United States</b> | USA      | 2022-03-28 | 5.601818e+08       | 2.553624e+08      |                         | 2.174990e+08 |
| <b>Brazil</b>        | BRA      | 2022-03-29 | 4.135596e+08       | 1.810781e+08      |                         | 1.602729e+08 |
| <b>Indonesia</b>     | IDN      | 2022-03-29 | 3.771089e+08       | 1.962409e+08      |                         | 1.588305e+08 |
| <b>Japan</b>         | JPN      | 2022-03-29 | 2.543456e+08       | 1.024675e+08      |                         | 1.006337e+08 |
| <b>Bangladesh</b>    | BGD      | 2022-03-29 | 2.436427e+08       | 1.275441e+08      |                         | 1.077127e+08 |
| <b>Pakistan</b>      | PAK      | 2022-03-10 | 2.193686e+08       | 1.280741e+08      |                         | 1.018812e+08 |
| <b>Vietnam</b>       | VNM      | 2022-03-22 | 2.031444e+08       | 7.994719e+07      |                         | 7.775411e+07 |
| <b>Mexico</b>        | MEX      | 2022-03-29 | 1.919079e+08       | 8.558029e+07      |                         | 7.971176e+07 |

In [57]:

```
plt.figure(figsize=(16, 7))
plt.bar(total_vacc_by_country.index, total_vacc_by_country.total_vaccinations)

plt.title('Total vaccinations per country')
plt.xticks(rotation = 90)
plt.ylabel('Total vaccinations')
plt.xlabel('Country')
plt.show()
```



In [58]: `#Sort by total vaccinations delivered by countries and group by vaccines.`  
`vacc_names_by_country = df.groupby('vaccines').max().sort_values('total_vaccinations',`  
`vacc_names_by_country.head()`

Out[58]:

| vaccines  | country       | iso_code | date       | total_vaccinations | people_vaccinated | people_fully_vaccinated |
|---|---------------|----------|------------|--------------------|-------------------|-------------------------|
| CanSino,<br>Sinopharm/Beijing,<br>Sinopharm/Wuhan,<br>Sinovac, ZF2001   | China         | CHN      | 2022-03-29 | 3.263129e+09       | 1.275541e+09      | 1.2401e+09              |
| Covaxin,<br>Oxford/AstraZeneca,<br>Sputnik V  | India         | IND      | 2022-03-29 | 1.834501e+09       | 9.848381e+08      | 8.2821e+08              |
| Johnson&Johnson,<br>Moderna,<br>Pfizer/BioNTech   | United States | USA      | 2022-03-28 | 5.601818e+08       | 2.553624e+08      | 2.1741e+08              |
| Johnson&Johnson,<br>Oxford/AstraZeneca,<br>Pfizer/BioNTech,<br>Sinovac  | Brazil        | BRA      | 2022-03-29 | 4.135596e+08       | 1.810781e+08      | 1.6021e+08              |
| Johnson&Johnson,<br>Moderna, Novavax,<br>Oxford/AstraZeneca,<br>Pfizer/BioNTech,<br>Sinopharm/Beijing,<br>Sinovac | Indonesia     | IDN      | 2022-03-29 | 3.771089e+08       | 1.962409e+08      | 1.5881e+08              |

In [59]: `#Get the top 10 vaccines by country for easy plotting`  
`vacc_names_by_country = vacc_names_by_country.iloc[:10]`  
`vacc_names_by_country`

Out[59]:

| vaccines  | country       | iso_code | date       | total_vaccinations | people_vaccinated | people_fully_v |
|---|---------------|----------|------------|--------------------|-------------------|----------------|
| <b>CanSino,<br/>Sinopharm/Beijing,<br/>Sinopharm/Wuhan,<br/>Sinovac, ZF2001</b>   | China         | CHN      | 2022-03-29 | 3.263129e+09       | 1.275541e+09      | 1.24           |
| <b>Covaxin,<br/>Oxford/AstraZeneca,<br/>Sputnik V</b>   | India         | IND      | 2022-03-29 | 1.834501e+09       | 9.848381e+08      | 8.28           |
| <b>Johnson&amp;Johnson,<br/>Moderna,<br/>Pfizer/BioNTech</b>  | United States | USA      | 2022-03-28 | 5.601818e+08       | 2.553624e+08      | 2.17           |
| <b>Johnson&amp;Johnson,<br/>Oxford/AstraZeneca,<br/>Pfizer/BioNTech,<br/>Sinovac</b>  | Brazil        | BRA      | 2022-03-29 | 4.135596e+08       | 1.810781e+08      | 1.60           |
| <b>Johnson&amp;Johnson,<br/>Moderna, Novavax,<br/>Oxford/AstraZeneca,<br/>Pfizer/BioNTech,<br/>Sinopharm/Beijing,<br/>Sinovac</b> | Indonesia     | IDN      | 2022-03-29 | 3.771089e+08       | 1.962409e+08      | 1.58           |
| <b>Moderna,<br/>Oxford/AstraZeneca,<br/>Pfizer/BioNTech</b>   | Wales         | SXM      | 2022-03-29 | 2.543456e+08       | 1.024675e+08      | 1.00           |
| <b>Johnson&amp;Johnson,<br/>Moderna,<br/>Oxford/AstraZeneca,<br/>Pfizer/BioNTech,<br/>Sinopharm/Beijing,<br/>Sinovac</b>          | Bangladesh    | BGD      | 2022-03-29 | 2.436427e+08       | 1.275441e+08      | 1.07           |
| <b>CanSino, Covaxin,<br/>Moderna,<br/>Oxford/AstraZeneca,<br/>Pfizer/BioNTech,<br/>Sinopharm/Beijing,<br/>Sinovac, Sputnik V</b>  | Pakistan      | PAK      | 2022-03-10 | 2.193686e+08       | 1.280741e+08      | 1.01           |
| <b>Abdala, Moderna,<br/>Oxford/AstraZeneca,<br/>Pfizer/BioNTech,<br/>Sinopharm/Beijing,<br/>Sputnik V</b>                         | Vietnam       | VNM      | 2022-03-22 | 2.031444e+08       | 7.994719e+07      | 7.77           |
| <b>CanSino,<br/>Johnson&amp;Johnson,<br/>Moderna,<br/>Oxford/AstraZeneca,<br/>Pfizer/BioNTech,<br/>Sinovac, Sputnik V</b>         | Mexico        | MEX      | 2022-03-29 | 1.919079e+08       | 8.558029e+07      | 7.97           |

```
In [60]: #Reset index to move vaccines from being index to a column.
#This makes it easy for us to plot using Seaborn, especially if we want to sort by country
vacc_names_by_country=vacc_names_by_country.reset_index()
vacc_names_by_country
```

Out[60]:

|     | vaccines   | country       | iso_code | date       | total_vaccinations | people_vaccinated | people_full |
|-----|--|---------------|----------|------------|--------------------|-------------------|-------------|
| 0   | CanSino,<br>Sinopharm/Beijing,<br>Sinopharm/Wuhan,<br>S... | China         | CHN      | 2022-03-29 | 3.263129e+09       | 1.275541e+09      | -           |
| 1   | Covaxin,<br>Oxford/AstraZeneca,<br>Sputnik V               | India         | IND      | 2022-03-29 | 1.834501e+09       | 9.848381e+08      | -           |
| 2   | Johnson&Johnson,<br>Moderna,<br>Pfizer/BioNTech            | United States | USA      | 2022-03-28 | 5.601818e+08       | 2.553624e+08      | -           |
| 3   | Johnson&Johnson,<br>Oxford/AstraZeneca,<br>Pfizer/Bi...    | Brazil        | BRA      | 2022-03-29 | 4.135596e+08       | 1.810781e+08      | -           |
| 4   | Johnson&Johnson,<br>Moderna, Novavax,<br>Oxford/Astr...    | Indonesia     | IDN      | 2022-03-29 | 3.771089e+08       | 1.962409e+08      | -           |
| 5   | Moderna,<br>Oxford/AstraZeneca,<br>Pfizer/BioNTech         | Wales         | SXM      | 2022-03-29 | 2.543456e+08       | 1.024675e+08      | -           |
| 6   | Johnson&Johnson,<br>Moderna,<br>Oxford/AstraZeneca,        | Bangladesh    | BGD      | 2022-03-29 | 2.436427e+08       | 1.275441e+08      | -           |
| ... |  |               |          |            |                    |                   |             |
| 7   | CanSino, Covaxin,<br>Moderna,<br>Oxford/AstraZeneca,...    | Pakistan      | PAK      | 2022-03-10 | 2.193686e+08       | 1.280741e+08      | -           |
| 8   | Abdala, Moderna,<br>Oxford/AstraZeneca,<br>Pfizer/Bi...    | Vietnam       | VNM      | 2022-03-22 | 2.031444e+08       | 7.994719e+07      | -           |
| 9   | CanSino,<br>Johnson&Johnson,<br>Moderna,<br>Oxford/Astr... | Mexico        | MEX      | 2022-03-29 | 1.919079e+08       | 8.558029e+07      | -           |

```
In [61]: plt.figure(figsize=(12,8))

sns.barplot(data = vacc_names_by_country, x='vaccines', y = 'total_vaccinations', hue
plt.xticks(rotation=90)
```

```
Out[61]: (array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9]),  
 [Text(0, 0, 'CanSino, Sinopharm/Beijing, Sinopharm/Wuhan, Sinovac, ZF2001'),  
  Text(1, 0, 'Covaxin, Oxford/AstraZeneca, Sputnik V'),  
  Text(2, 0, 'Johnson&Johnson, Moderna, Pfizer/BioNTech'),  
  Text(3, 0, 'Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac'),  
  Text(4, 0, 'Johnson&Johnson, Moderna, Novavax, Oxford/AstraZeneca, Pfizer/BioNTech,  
  Sinopharm/Beijing, Sinovac'),  
  Text(5, 0, 'Moderna, Oxford/AstraZeneca, Pfizer/BioNTech'),  
  Text(6, 0, 'Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinophar  
  m/Beijing, Sinovac'),  
  Text(7, 0, 'CanSino, Covaxin, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopha  
  rm/Beijing, Sinovac, Sputnik V'),  
  Text(8, 0, 'Abdala, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijin  
  g, Sputnik V'),  
  Text(9, 0, 'CanSino, Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech,  
  Sinovac, Sputnik V')])
```

