

# Covid-19 Vaccines Analysis

Many vaccines have been introduced so far to fight covid-19. No vaccine has guaranteed 100% accuracy so far, but most manufacturing companies claim their vaccine is not 100% accurate, but still, it will save your life by giving you immunity.

Thus, each country tries to vaccinate a large part of its population so as not to depend on a single vaccine. That's what I'm going to analyze in this article, which is how many vaccines each country is using to fight covid-19. In the section below, I will take you through a data science tutorial on Covid-19 vaccines analysis with Python.

let's start.....

importing libraries

```
In [1]: import numpy as np  
import pandas as pd  
import matplotlib.pyplot as plt  
import seaborn as sns
```

read data and describe it.

```
In [4]: data = pd.read_csv("country_vaccinations.csv")  
data.head()
```

Out[4]:

	country	iso_code	date	total_vaccinations	people_vaccinated	people_fully_vaccinated	daily_vaccinations
0	Afghanistan	AFG	2021-02-22	0.0	0.0	NaN	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 [5]: data.describe()
```

Out[5]:

	total_vaccinations	people_vaccinated	people_fully_vaccinated	daily_vaccinations_raw	daily_
count	1.452200e+04	1.376200e+04	1.104100e+04	1.200300e+04	2
mean	9.139252e+06	4.737802e+06	2.681353e+06	2.012910e+05	1
std	4.592776e+07	1.797156e+07	1.093032e+07	1.122962e+06	7
min	0.000000e+00	0.000000e+00	1.000000e+00	0.000000e+00	0
25%	1.005620e+05	7.876700e+04	3.719700e+04	3.967500e+03	8
50%	7.007560e+05	5.149065e+05	2.834740e+05	1.988600e+04	6
75%	3.241681e+06	2.139073e+06	1.192415e+06	8.257600e+04	3
max	1.029223e+09	6.220000e+08	2.232990e+08	2.360500e+07	2

## Note that !

The United Kingdom is made up of England, Scotland, Wales, and Northern Ireland. But in the above data, these countries are

mentioned separately with the same values as in the United Kingdom. ***So this may be an error while recording this data.***

```
In [43]: pd.to_datetime(data.date)  
data.country.value_counts()
```

```
Out[43]: Norway                201  
Scotland              193  
Canada                189  
China                 188  
Russia                188  
...  
Burkina Faso           13  
Turkmenistan            1  
Bonaire Sint Eustatius and Saba    1  
Chad                  1  
Pitcairn               1  
Name: country, Length: 217, dtype: int64
```

***So let's see how we can fix this error:***

```
In [44]: data = data[data.country.apply(lambda x: x not in ["England", "Scotland", "Wales"])]  
data.country.value_counts()
```

```
Out[44]: Norway          201  
Canada           189  
China            188  
Russia           188  
Denmark          186  
...  
Burkina Faso     13  
Turkmenistan      1  
Bonaire Sint Eustatius and Saba 1  
Chad              1  
Pitcairn          1  
Name: country, Length: 213, dtype: int64
```

**Now let's explore the vaccines available in this dataset:**

```
In [45]: data.vaccines.value_counts()
```

```
Out[45]: Oxford/AstraZeneca  
4326  
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech  
3437  
Oxford/AstraZeneca, Pfizer/BioNTech  
1697  
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech  
1517  
Moderna, Pfizer/BioNTech  
1394  
Pfizer/BioNTech  
1143  
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V  
1122  
Oxford/AstraZeneca, Sinopharm/Beijing  
1082  
Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac  
1033  
Oxford/AstraZeneca, Sputnik V  
558  
Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik V  
499  
Oxford/AstraZeneca, Sinopharm/Beijing, Sputnik V  
462  
BBIBP-CorV, Oxford/AstraZeneca  
450  
Johnson&Johnson, Moderna, Pfizer/BioNTech  
369  
Oxford/AstraZeneca, Sinovac  
364  
Sinopharm/Beijing  
306  
BBIBP-CorV, Sputnik V  
290  
Pfizer/BioNTech, Sinovac  
278  
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing  
268  
Oxford/AstraZeneca, Sinovac, Sputnik V  
231  
Moderna, Oxford/AstraZeneca  
207  
Covaxin, Oxford/AstraZeneca  
192  
CanSino, Sinopharm/Beijing, Sinopharm/Wuhan, Sinovac  
188  
EpiVacCorona, Sputnik V  
188  
CanSino, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik V  
178  
CanSino, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac  
177  
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V    171
```

Sinopharm/Beijing, Sputnik V  
169

Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinopharm/Wuhan, Sputnik V 167

BBIBP-CorV, Oxford/AstraZeneca, Sinovac, Sputnik V  
148

BBIBP-CorV, Covaxin, Oxford/AstraZeneca  
147

Moderna  
143

QazVac, Sinopharm/HayatVax, Sputnik V  
141

CanSino, Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac, Sputnik V  
138

Pfizer/BioNTech, Sinopharm/Beijing  
133

Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac  
132

BBIBP-CorV, Covaxin, Oxford/AstraZeneca, Sputnik V  
127

Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac  
126

Johnson&Johnson, Pfizer/BioNTech  
124

Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac, Sputnik V  
122

Covaxin, Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac, Sputnik V  
117

Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech  
116

Pfizer/BioNTech, Sputnik V  
114

BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech  
113

Johnson&Johnson, Moderna, Oxford/AstraZeneca, Sputnik V  
111

BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech, Sputnik V  
106

BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac  
103

Sputnik V  
81

Oxford/AstraZeneca, RBD-Dimer, Sputnik V  
77

BBIBP-CorV, Moderna, Oxford/AstraZeneca, Sputnik V  
68

BBIBP-CorV, Oxford/AstraZeneca, Sinovac  
63

Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik V 61

Covaxin, Oxford/AstraZeneca, Sinopharm/Beijing  
49

Abdala, Soberana02  
32

BBIBP-CorV  
1

EpiVacCorona, Oxford/AstraZeneca, Sinopharm/Beijing, Sputnik V

```
1  
Name: vaccines, dtype: int64
```



## explore which vaccine is taken by which country

So we have almost all the Covid-19 vaccines available in this dataset. Now I will create a new DataFrame by only selecting

the vaccine and the country columns to explore which vaccine is taken by which country:

```
In [6]: df = data[["vaccines", "country"]]  
df.head()
```

Out[6]:

	vaccines	country
0	BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech	Afghanistan
1	BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech	Afghanistan
2	BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech	Afghanistan
3	BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech	Afghanistan
4	BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech	Afghanistan

Now let's see how many countries are taking each of the vaccines mentioned in this data:

```
In [47]: dict_ = {}
for i in df.vaccines.unique():
    dict_[i] = [df["country"][j] for j in df[df["vaccines"]==i].index]

vaccines = {}
for key, value in dict_.items():
    vaccines[key] = set(value)
for i, j in vaccines.items():
    print(f"{i}:>{j}")

BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech:>>{'Afghanistan'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik V:>>{'Tunisia', 'Bosnia and Herzegovina', 'Philippines', 'Albania'}
Oxford/AstraZeneca, Sputnik V:>>{'Nicaragua', 'Ghana', 'Algeria', 'Guyana', 'Kenya'}
Oxford/AstraZeneca, Pfizer/BioNTech:>>{'Australia', 'Andorra', 'Cape Verde', 'Saudi Arabia', 'Cayman Islands', 'Slovenia', 'Isle of Man', 'Oman', 'Sweden', 'Panama', 'Costa Rica'}
Oxford/AstraZeneca:>>{'Solomon Islands', 'Fiji', 'Sao Tome and Principe', 'French Polynesia', 'Tonga', 'Bangladesh', 'Burkina Faso', 'Malawi', 'Saint Helena', 'Madagascar', 'Barbados', "Cote d'Ivoire", 'Jamaica', 'Georgia', 'Eswatini', 'Kosovo', 'Ethiopia', 'Botswana', 'Vietnam', 'Wallis and Futuna', 'Tajikistan', 'South Sudan', 'Pitcairn', 'Mali', 'Myanmar', 'Grenada', 'Cook Islands', 'Bhutan', 'Saint Kitts and Nevis', 'Trinidad and Tobago', 'Antigua and Barbuda', 'Yemen', 'Bahamas', 'Saint Lucia', 'Tuvalu', 'Anguilla', 'Dominica', 'Democratic Republic of Congo', 'Saint Vincent and the Grenadines', 'Falkland Islands', 'Togo', 'Suriname', 'Nigeria', 'Samoa', 'Liberia', 'Montserrat', 'Vanuatu', 'Nauru', 'British Virgin Islands', 'Lesotho', 'Angola', 'Uganda'}
Oxford/AstraZeneca, Sinopharm/Beijing, Sputnik V:>>{'Argentina', 'Djibouti', 'Syria', 'Sri Lanka'}
Oxford/AstraZeneca, Sinovac, Sputnik V:>>{'Azerbaijan', 'Armenia'}
Pfizer/BioNTech:>>{'Monaco', 'Aruba', 'Bermuda', 'Turks and Caicos Islands', 'New Caledonia', 'Gibraltar', 'Kuwait', 'New Zealand'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech:>>{'Spain', 'Portugal', 'Romania', 'Czechia', 'Belgium', 'Poland', 'Ireland', 'Italy', 'Iceland', 'Latvia', 'Malta', 'Germany', 'Lithuania', 'Bulgaria', 'Austria', 'Cyprus', 'Estonia', 'Greece', 'France', 'Netherlands'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V:>>{'Lebanon', 'Serbia', 'Mongolia', 'Bolivia', 'Jordan', 'Montenegro', 'Moldova', 'Bahrain'}
BBIBP-CorV, Sputnik V:>>{'Belarus', 'Venezuela'}
Oxford/AstraZeneca, Sinopharm/Beijing:>>{'Brunei', 'Belize', 'Namibia', 'Gambia', 'Mozambique', 'Nepal', 'Seychelles', 'Papua New Guinea', 'Zambia', 'Morocco', 'Guinea-Bissau'}
Oxford/AstraZeneca, Sinovac:>>{'Timor', 'Thailand', 'Benin', 'Indonesia'}
Moderna, Pfizer/BioNTech:>>{'Liechtenstein', 'Curacao', 'Bonaire Sint Eustatius and Saba', 'Norway', 'Faeroe Islands', 'Switzerland', 'Israel', 'Japan', 'Qatar', 'Singapore'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac:>>{'El Salvador', 'Ecuador', 'Brazil', 'Uruguay', 'Northern Cyprus', 'Colombia', 'Ukraine', 'Malaysia'}
Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac:>>{'Cambodia'}
BBIBP-CorV, Oxford/AstraZeneca:>>{'Sierra Leone', 'Senegal', 'Niger', 'Cameroon', 'Mauritania'}
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech:>>{'Jersey', 'Finland', 'Sint Maarten (Dutch part)', 'Slovakia', 'Rwanda', 'Palestine', 'Guernsey', 'Canada', 'Croatia', 'United Kingdom', 'Luxembourg'}
Covaxin, Oxford/AstraZeneca:>>{'India', 'Central African Republic'}
```

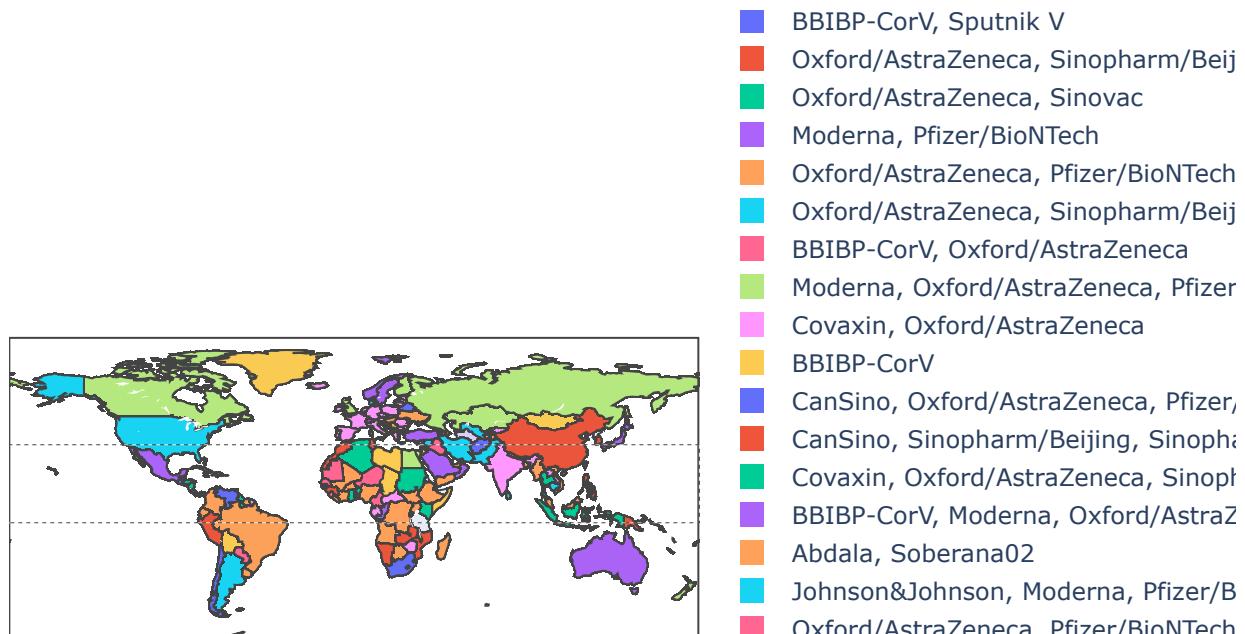
BBIBP-CorV:>>{'Chad'}  
CanSino, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac:>>{'Chile'}  
CanSino, Sinopharm/Beijing, Sinopharm/Wuhan, Sinovac:>>{'China'}  
Covaxin, Oxford/AstraZeneca, Sinopharm/Beijing:>>{'Comoros'}  
BBIBP-CorV, Moderna, Oxford/AstraZeneca, Sputnik V:>>{'Congo'}  
Abdala, Soberana02:>>{'Cuba'}  
Johnson&Johnson, Moderna, Pfizer/BioNTech:>>{'Denmark', 'United States'}  
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac:>>{'Dominican Republic'}  
BBIBP-CorV, Oxford/AstraZeneca, Sinovac, Sputnik V:>>{'Egypt'}  
Sinopharm/Beijing:>>{'Gabon', 'Zimbabwe', 'Equatorial Guinea'}  
Moderna:>>{'Greenland'}  
Moderna, Oxford/AstraZeneca:>>{'Taiwan', 'Guatemala'}  
Sputnik V:>>{'Guinea'}  
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Sputnik V:>>{'Honduras'}  
Pfizer/BioNTech, Sinovac:>>{'Hong Kong', 'Turkey'}  
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V:>>{'Hungary'}  
BBIBP-CorV, Covaxin, Oxford/AstraZeneca, Sputnik V:>>{'Iran'}  
BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech, Sputnik V:>>{'Iraq'}  
QazVac, Sinopharm/HayatVax, Sputnik V:>>{'Kazakhstan'}  
Sinopharm/Beijing, Sputnik V:>>{'Kyrgyzstan', 'Laos'}  
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik V:>>{'Libya'}  
Pfizer/BioNTech, Sinopharm/Beijing:>>{'Macao'}  
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing:>>{'Maldives', 'Peru'}  
BBIBP-CorV, Covaxin, Oxford/AstraZeneca:>>{'Mauritius'}  
CanSino, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik V:>>{'Mexico'}  
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac, Sputnik V:>>{'North Macedonia'}  
CanSino, Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac, Sputnik V:>>{'Pakistan'}  
Covaxin, Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac, Sputnik V:>>{'Paraguay'}  
EpiVacCorona, Sputnik V:>>{'Russia'}  
Pfizer/BioNTech, Sputnik V:>>{'San Marino'}  
BBIBP-CorV, Oxford/AstraZeneca, Sinovac:>>{'Somalia'}  
Johnson&Johnson, Pfizer/BioNTech:>>{'South Africa'}  
Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech:>>{'South Korea'}  
BBIBP-CorV, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac:>>{'Sudan'}  
EpiVacCorona, Oxford/AstraZeneca, Sinopharm/Beijing, Sputnik V:>>{'Turkmenistan'}  
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinopharm/Wuhan, Sputnik V:>>{'United Arab Emirates'}  
Oxford/AstraZeneca, RBD-Dimer, Sputnik V:>>{'Uzbekistan'}

## Data visualization

Now let's visualize this data to have a look at what combination of vaccines every country is using:

```
In [7]: import matplotlib.pyplot as plt
import plotly
import plotly.express as px
import plotly.offline as py
```

```
In [8]: vaccine_map = px.choropleth(data, locations = 'iso_code', color = 'vaccines')
vaccine_map.update_layout(height=500, margin={"r":0,"t":0,"l":0,"b":0})
vaccine_map.show()
```



```
In [61]: !pip install plotly
```

```
Requirement already satisfied: plotly in c:\users\mohamed\anaconda3\lib\site-pa
ckages (5.3.1)
Requirement already satisfied: tenacity>=6.2.0 in c:\users\mohamed\anaconda3\li
b\site-packages (from plotly) (8.0.1)
Requirement already satisfied: six in c:\users\mohamed\anaconda3\lib\site-packa
ges (from plotly) (1.15.0)
```

```
In [ ]:
```

