

Title: Implementation and Analysis of Variant Emergence and Vaccination Rollout

Objective:

The objective of this report is to describe the implementation of a searchable database and analyze the relationship between variant emergence and vaccination rollout. The report outlines the dataset sources, methodology, and provides an analysis of the trends observed.

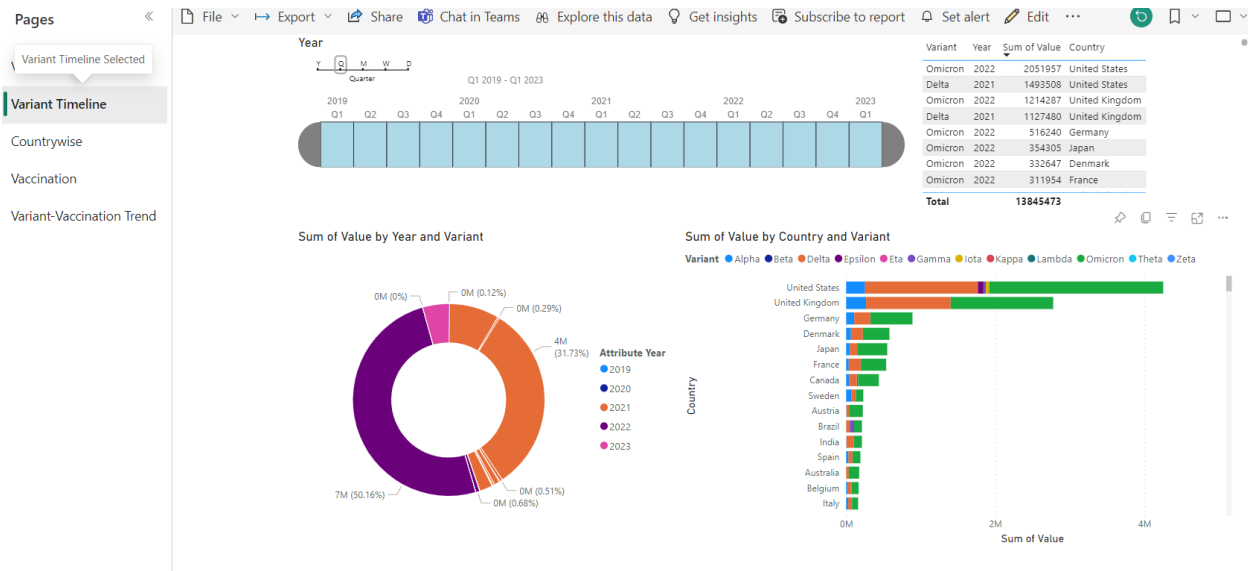
Dataset:

For variant data, the GISAID (Global Initiative on Sharing All Influenza Data) dataset from the website <https://gisaid.org/> was utilized to determine the emergence of different variants. The dataset was transformed and categorized based on specific variants and countries. A total of 217 countries' data was included in the analysis. For vaccination data, the "Our World in Data" dataset from the website <https://ourworldindata.org/covid-vaccinations> was used to understand the number of cases per country within a given timeframe.

Methodology:

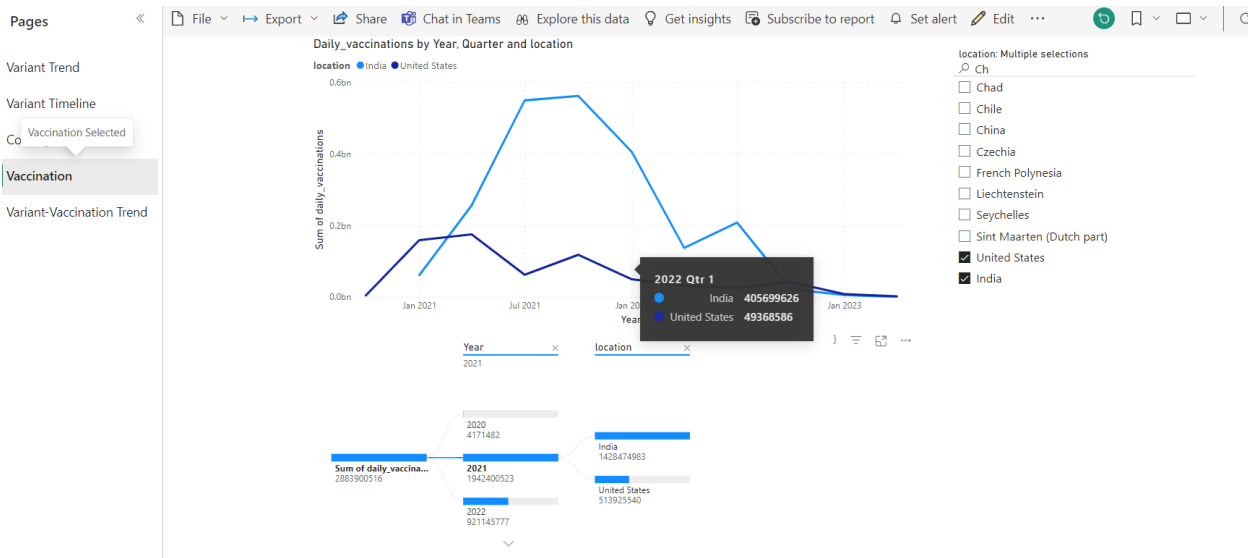
1. Variant Data:

- The dataset was transformed and organized based on variant and country.
- A Power BI dashboard ([Link](#)) was created to visualize the trends of the variants.
- The dashboard consists of 5 pages:
 - a. The first page provides an overview of different variants worldwide and their distribution across countries.
 - b. The second page illustrates the trend of variants over time, indicating the dominant variants during specific periods.
 - c. The third page presents an overall view of variants per year and per country, providing a percentage distribution.
 - d. The fourth page presents vaccination data and how vaccination took place.
 - e. The fifth page presents vaccination and variant details which is further explained in Vaccine-variant relation in Analysis.



2. Vaccination Data:

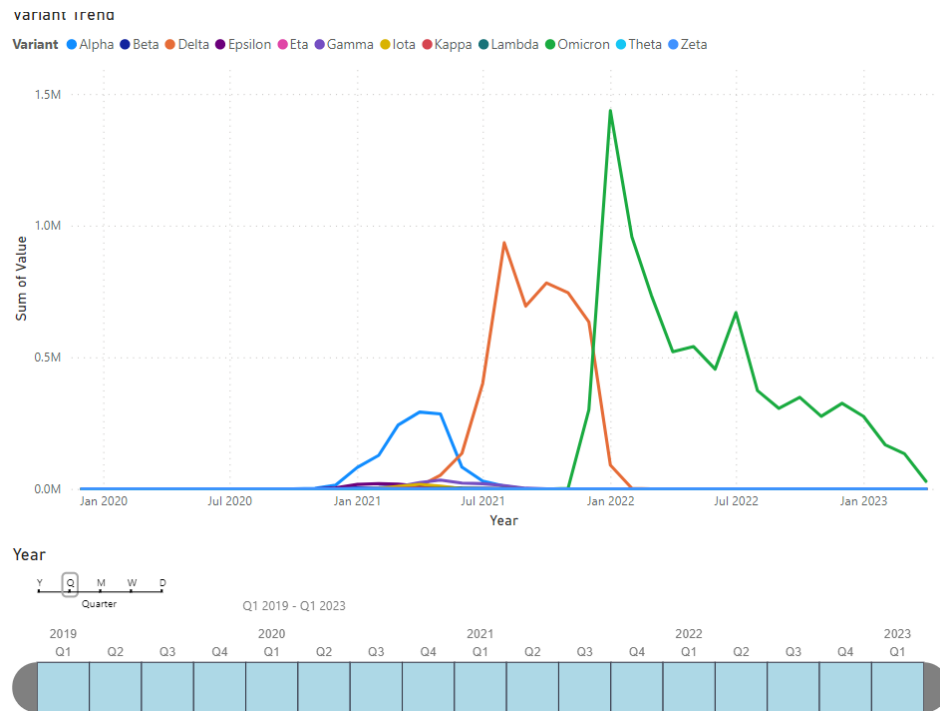
- The dataset was transformed and categorized by country, starting from February 2020.
- A vaccination page ([Link](#)) was created to integrate the vaccine data, enabling a comprehensive analysis of global trends.



Analysis:

1. Variant Trend:

- The trend analysis reveals that the Alpha variant peaked around April 2021, followed by the rise of the Delta variant in June 2021, becoming the dominant variant.



- The Delta variant peaked around August 2021, and the Omicron variant emerged as the dominant variant after December 2021.

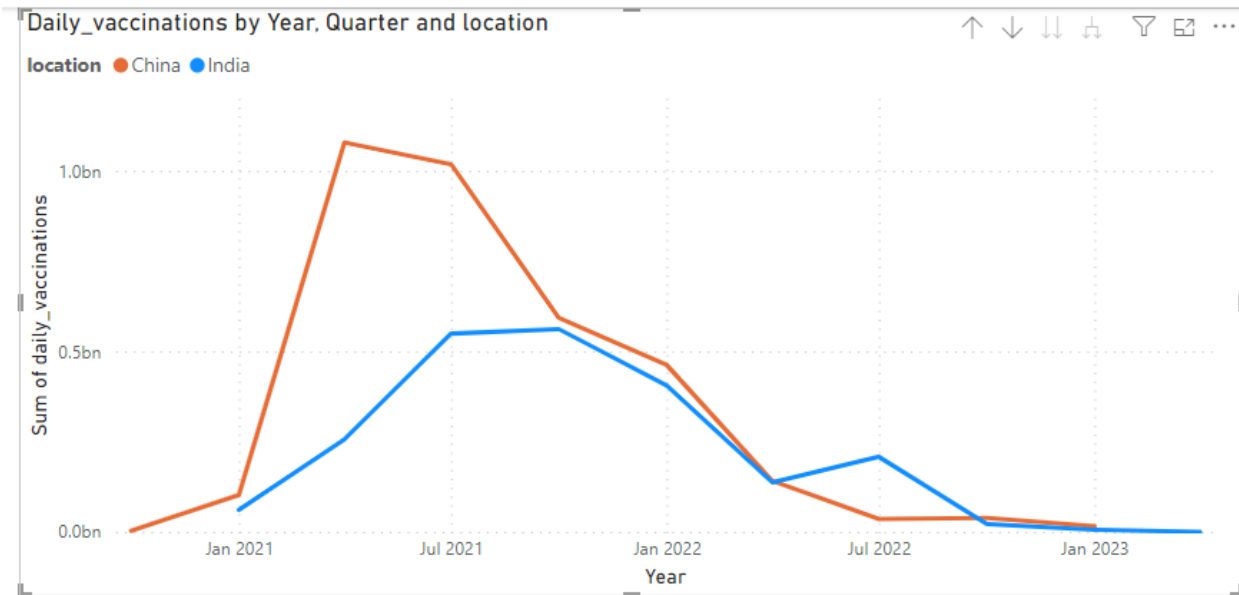
- This observation suggests that multiple variants may coexist initially, but the dominant variant can change over time, potentially influenced by factors such as lineage.

Row Labels	Delta	Omicron
Jan	90526	1436804
Feb	2764	956993
Mar	515	735992
Apr	164	520980
May	230	540581
Jun	85	455318
Jul	62	669752
Aug	33	373484
Sep	33	306071
Oct	60	348108
Nov	14	275912
Dec	12	325463

The above tables give the idea of coexistence of the two variants in 2022.

2. Vaccination Trend:

- The vaccination trend analysis demonstrates that countries like China and India, due to their large populations, have higher vaccination numbers.



- The trend shows a peak in vaccination rates during the third and fourth quarters of 2021. However, a significant drop in vaccination rates is observed subsequently.

- It is challenging to determine if the decline was solely due to variant surges or influenced by other factors, such as government policies and vaccine availability.

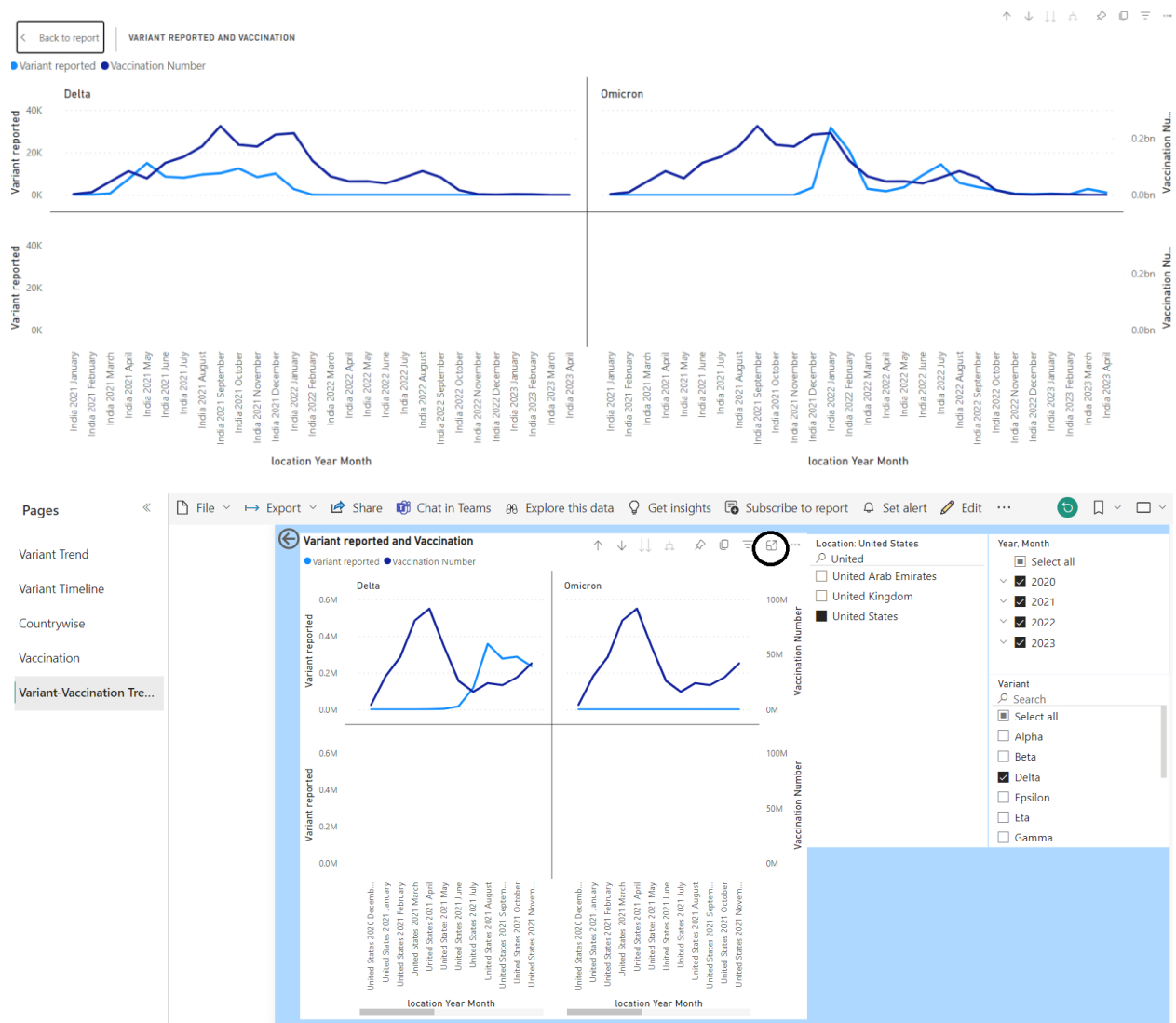
Domestic vaccine production capacity: Both China and India have large domestic vaccine production capacities and existing infrastructure that enabled them to quickly manufacture COVID-19 vaccines. Companies like Sinovac and Sinopharm in China and Serum Institute of India were able to rapidly scale up production.

<https://www.cnn.com/2021/01/29/how-covid-19-vaccines-can-shape-china-and-indias-global-influence.html>

Early approval and roll-out: Chinese and Indian regulators approved some COVID-19 vaccines for early/emergency use while Phase 3 trials were still underway. This allowed the countries to start administering vaccines months before efficacy data was fully available. There was less regulatory scrutiny compared to the US/Europe.

3. Vaccine-Variant Relation:

Looking at the below we can see how the two different variants vs vaccination looks like. There is a increase for delta and then Omicron started to move at a higher pace. Coming to the vaccination with an increase in the number of vaccinations there is a fall in delta variant reported but once we see a steady vaccination then reporting these variant increases for Omicron. Which indicate that vaccination if increase can lower the number of variant reporting but by keeping constant then it might be creating another variant. Hence once there is a rise in the number of vaccination then the variant reporting seems to be dropping.



- To gain a deeper understanding, a breakdown of specific countries was conducted to analyze the relationship between vaccines and variants can be done using another dashboard.
- The dashboard ([Link](#)) gives the trendline of both vaccine and variant for a specific country and world.
- The combined dataset of vaccine and variant with same timeline that is January 2020 – April 2023.

- Examining the trend for a specific period (Q3-Q4 2021 to Q2 2022), India experienced a spike in Omicron variant cases accompanied by a decrease in vaccinations.

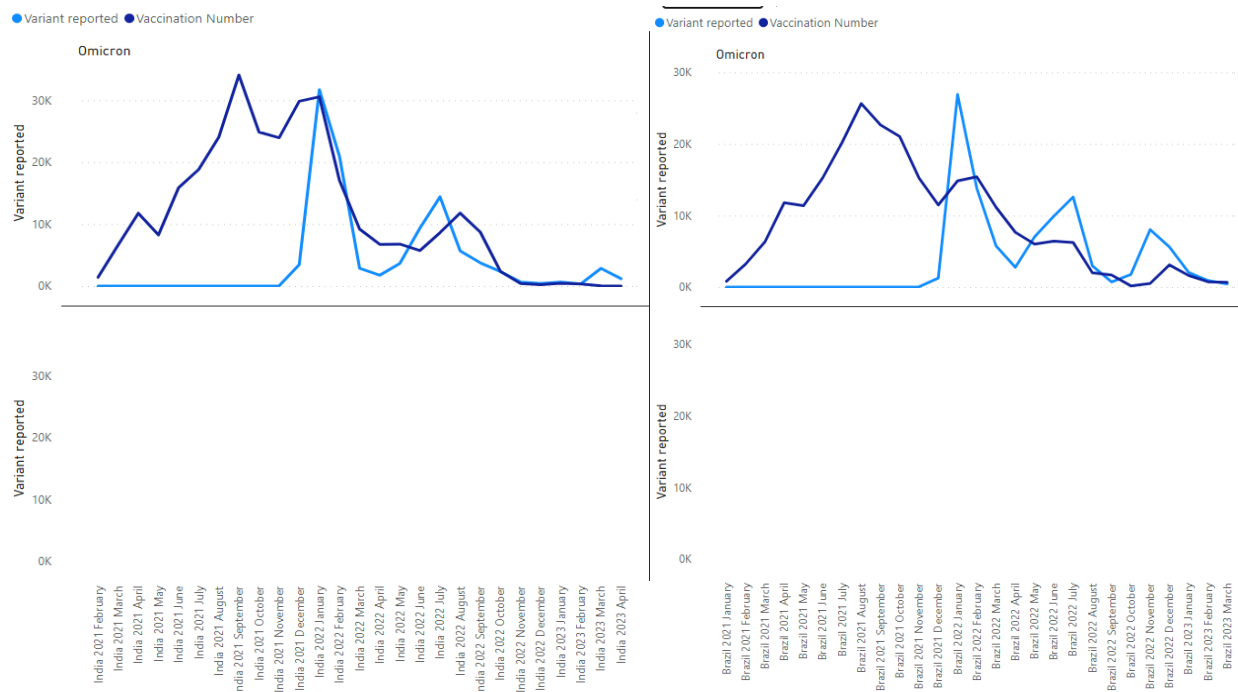
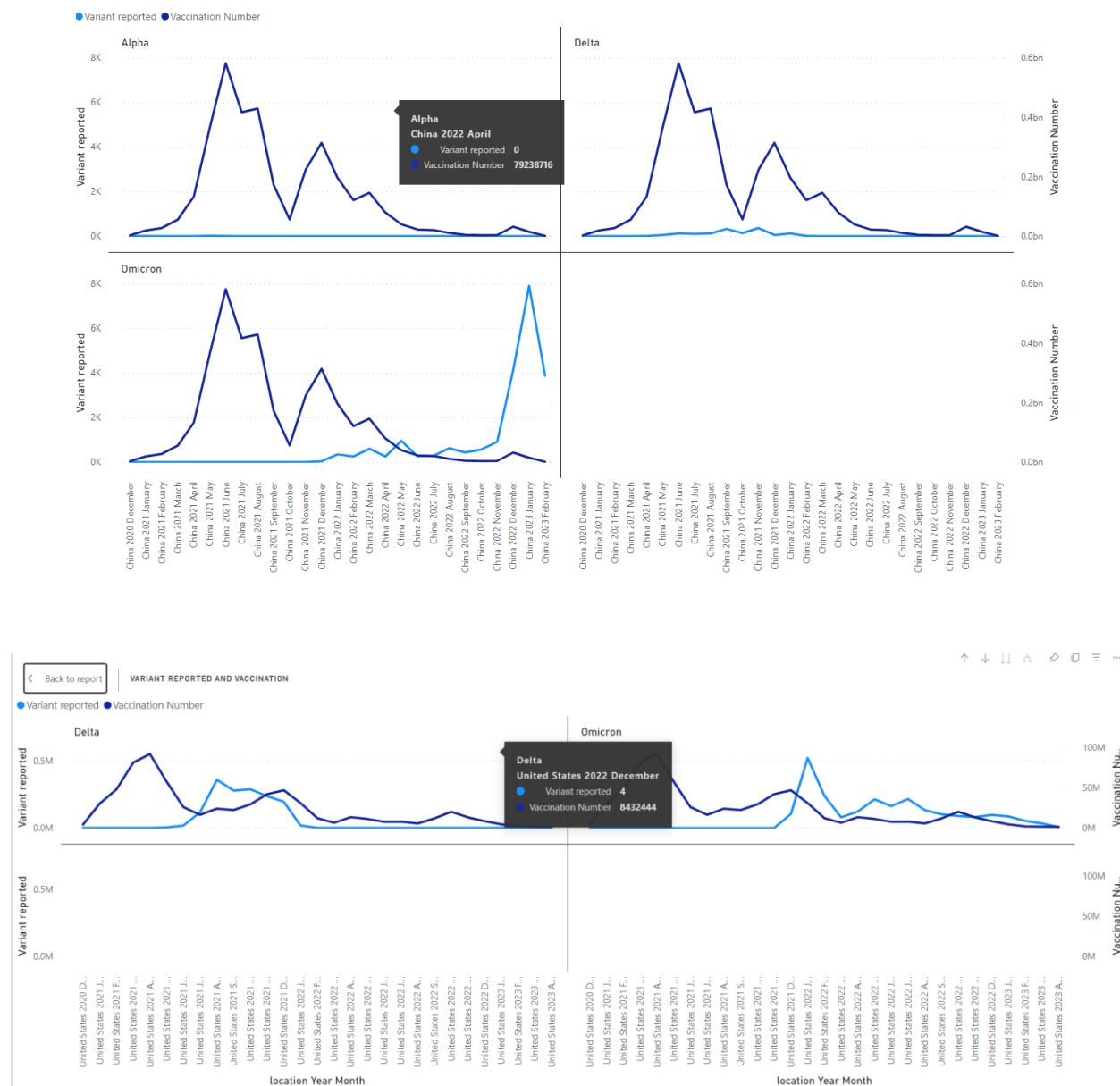


Figure: India and Brazil comparsion

Variant	Omicron	
Month	(All)	
	Brazil	India
2021		
Variant Value	1306	3482
Sum of daily_vaccinations	330036341	1428474983
2022		
Variant Value	97855	97465
Sum of daily_vaccinations	150365971	772726041
2023		
Variant Value	3412	5021
Sum of daily_vaccinations	6041568	5899829

- Similarly, Brazil exhibited prominence in three different variants during that period, with an increase in cases and a drop in vaccinations.

- Considering China as an example for 3 different variants (Alpha, Delta, Omicron), there is a clear dominance of one variant but also two variants at a same time.



Lets investigate United States, being more variant reported cases, looking at the number of vaccinations seems to be going down.

- In the context of vaccination trends, it's noteworthy that there are specific time periods when the vaccination rates and the prevalence of variants appear to exhibit simultaneous increases. However, it's important to emphasize that this pattern doesn't necessarily apply universally across all countries. The scales of these trends may differ significantly, but there is indeed a discernible correlation. It underscores

the complex interplay between vaccination efforts and the evolution of virus variants, highlighting the need for tailored strategies and a nuanced understanding of the global landscape.

Conclusion:

The implementation of a searchable database and the analysis of variant emergence and vaccination rollout provides valuable insights into global trends. The analysis indicates the changing dominance of different variants over time and highlights potential factors affecting vaccination rates. Further investigation into the vaccine-variant relationship in specific countries is crucial to understanding the dynamics between variants and vaccination efforts.

References:

 [Combined_all.xlsx](#)

[Vaccination data](#)

[Coronavirus \(COVID-19\) Vaccinations - Our World in Data](#)

[covid-19-data/public/data/vaccinations at master · owid/covid-19-data · GitHub](#)

<https://gisaid.org/hcov19-variants/>