



## Data Analytics and Prediction Model for Malaysian Covid 19 Vaccination Progress

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### KEYWORDS

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### ABSTRACT

SARS CoV-2 varieties keep developing, triggering disease outbreaks and delaying or even halting the opening of society and economies. In countries with high vaccination rates, there have been significant decreases in serious illness, hospitalization, and mortality. Nevertheless, vaccine availability is unequal internationally, with coverage varying from 1% to over 70%, primarily dependent on the nation's income. This study focuses on conducting data analytics and prediction model on the impact and intensity of the Covid-19 global vaccination trend compared to Malaysia. The country's vaccination performance is compared and analyzed with G7 countries such as Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. Moreover, the vaccination rate of Malaysia and several SEA countries have also been compared in this study. This study discusses vital information such as the type of vaccines and vaccination rates. Meanwhile, the prediction model's goal is to predict the country's future vaccination trend.

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## 1. INTRODUCTION

The COVID-19 pandemic continues to be a severe international emergency more than two years after the first SARS-CoV-2 illnesses were identified. The Omicron Variant of Concern, which appeared and expanded quickly near the end of 2021, caused a previously unheard-of global acceleration of SARS-CoV-2 transmission. One-third of the 433 million cases recorded up to 28 February since the start of the pandemic, more than 143 million new cases had been reported globally in just the first two months of 2022 [1]. Although COVID-19 is currently hitting countries in various diverse ways, the pandemic is still ongoing.

COVID-19 continues to significantly influence world health, resulting in an unacceptable number of fatalities and serious illnesses. Up to the end of February 2022, WHO has received reports of about six million COVID-19 fatalities, an unacceptable high amount that is very definitely an underestimate. More than 75,000 deaths attributed to COVID-19 were recorded in just the first week of February; this is an unacceptable high amount that is likely an underestimate. Long-lasting and incapacitating sequelae will have an impact

on thousands more people. Despite regional differences, overall transmission is still robust, which raises the possibility of novel variations.

One year into the COVID-19 coronavirus disease pandemic, the global effort to create and disseminate an efficient vaccine resulted in several secure and efficient options. Multiple vaccinations are currently being developed at an expedited rate; formerly, the procedure took between eight and fifteen years [3]. The immunization of a critical mass of the worldwide population, which is essential for bringing the pandemic under control, still faces difficulties, including risky new virus strains like omicron, international rivalry for a finite number of doses, and public skepticism about the vaccines.

## 2. LITERATURE REVIEW

### 2.1 A Guide to Global COVID-19 Vaccine Efforts [3]

Several nations have approved more than thirty vaccinations for routine or urgent usage. Over eleven billion

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doses have been given out globally as of the beginning of 2022. At least three-quarters of the populace has received all recommended vaccinations in dozens of nations; the most outstanding immunization rates are in Portugal, Singapore, and the United Arab Emirates.

Many nations introduced vaccination requirements to maintain development. For instance, immunization against COVID-19 is required for both public and commercial sector employees in Italy and Saudi Arabia. The same was done in the US for major commercial businesses and the public sector, but the Supreme Court stopped the latter mandate, and additional legal challenges are now pending. Only requirements for healthcare professionals have been passed in other nations. The availability of COVID-19 vaccinations for children is also progressively increasing; in China, children as young as three are eligible, but in the United States, children must be at least five years old.

## 2.2 Coronavirus (COVID-19) vaccines for developing countries: An equal shot at recovery [4]

New vaccinations are anticipated in 2021 and 2022 by the world's largest and wealthiest economies, but the issue of providing fair access to vaccines worldwide remains up for discussion. By mid-2022, most adults in advanced economies will have had their vaccinations, according to current projections.

Considering the present trend, mass immunization programs for developing nations may not begin until 2024 or later, prolonging the suffering of people and the global economy. Supporting multilateral frameworks for equitable vaccine allocation and crisis response, resilience, and prevention are just a few examples of policy actions to support equitable vaccine access in developing countries. Other measures include highlighting the importance of development finance and promoting context-driven solutions. [4]

## 2.3 Does the World Still Need New Covid-19 Vaccines? [5]

Despite a global scarcity of COVID-19 vaccinations in 2021, by the middle of 2022, attempts to ensure the vaccine supply would no longer constrain equal coverage. The World Health Organization (WHO) predicted that mid-2022 would cover 70 percent of the world's population if manufacturing capacity for currently available vaccines were scaled up at the rate promised by vaccine manufacturers through the COVAX (Covid-19 Vaccines Global Access) programme and beyond. Around 11.5 billion doses of the Covid-19 vaccine have been given worldwide since 19 April 2022.

Each vaccination product has unique qualities, benefits, and drawbacks, and several aspects must be considered when making policy choices. Different vaccination products created on various platforms may benefit various subpopulations, age groups, nations, and healthcare environments. When a country decides to purchase and distribute new Covid-19 vaccines, other outcomes than efficacy and safety, as determined by phase 3 studies, must also be considered. Additional significant factors include the simplicity of schedules, vaccine effectiveness when used in routine programs, the requirement and frequency of booster shots, cost, logistics considerations for the cold chain, manufacturing scalability, acceptability by

communities, and potential for local or regional production. [5]

## 2.4 Individual Variation in Susceptibility or Exposure to SARS-CoV-2 Lowers the Herd Immunity Threshold [6]

Even if various management efforts slow down and ultimately stop the local spread of COVID-19 illness, the community is still in danger of resurgence because of inadequate immune system development. Herd immunity would be a barrier to stopping the spread of disease if it could be created. Researchers conclude that vaccination campaigns may have had a minor impact on the development of herd immunity in people with high levels of innate immunity. Still, they were essential in preventing disastrous consequences when the virus spread endemic [6].

## 2.5 Herd immunity and vaccination of children for COVID-19 [7]

Studies on the COVID-19 vaccine are crucial to protecting older people from the disease, but to stop the spread of the illness and create herd immunity, a high vaccination rate, even among children, may be required. Children's COVID-19 vaccine trials will enable the creation of vaccination policies based on scientific evidence. When paired with more reliable information on the involvement of children in transmission, they might significantly aid decision-making. Adults must be the principal target demographic for future COVID-19 vaccine research and development. Children, a significant demographic that may benefit from direct protection and who are crucial to the population's general immunity, should not be disregarded.

## 3. DATA ANALYSIS

### 3.1 Countries that are the quickest to attain an 80 percent vaccination rate

According to the data collected as of 30 March 2022, table 3.1 shows the fastest countries to reach an 80% vaccination rate. Twenty-six countries have gone the 80% vaccination rate at this point. Unfortunately, Malaysia is not one of the countries to achieve the 80% vaccination rate until 30 March 2022. The vaccination rate in Malaysia until 29 March 2022 was 78.72%. Gibraltar is the first country to achieve more than 80% vaccination rate, whereas the Cook Islands holds the last place on this list.

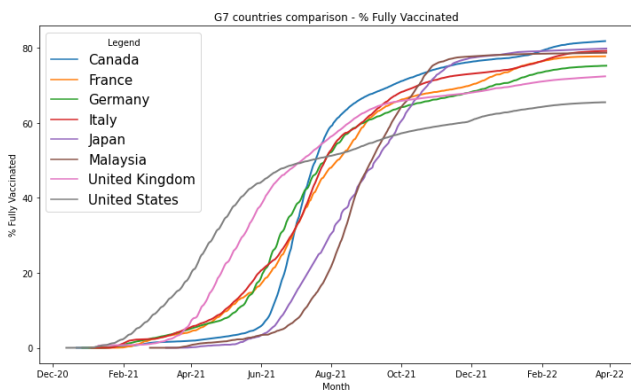
### 3.2 Vaccination rates of Malaysia compared with G7 countries

Seven of the world's most developed economies—Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States—combine to create the G7 [8].

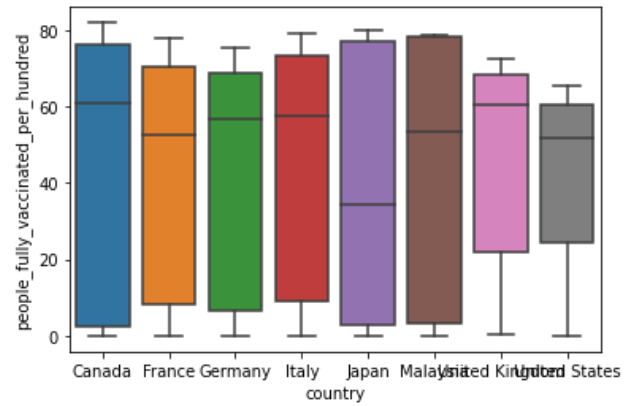
Figure 1 shows Malaysia's vaccination progress started later than the G7 countries. However, Malaysia's vaccination rate of fully vaccinated people was the highest from October 2021 to November 2021. At the end of March 2022, Canada had the highest fully vaccinated percentage, followed by Japan, Italy, Malaysia, France, Germany, the United Kingdom, and the United States.

**Table 1:** Fastest countries to reach 80% vaccination rate

country	date	people_fully_vaccinated_per_hundred
Gibraltar	2021-03-27	82.11
Malta	2021-09-01	80.03
Pitcairn	2021-09-07	100.00
Portugal	2021-09-12	81.10
United Arab Emirates	2021-09-18	80.18
Singapore	2021-09-25	80.10
Cayman Islands	2021-10-22	80.73
Chile	2021-11-04	80.16
Spain	2021-11-09	80.05
Cuba	2021-11-21	80.01
South Korea	2021-11-29	80.20
Brunei	2021-12-07	80.99
China	2021-12-10	80.49
Cambodia	2021-12-13	80.01
Faeroe Islands	2021-12-22	82.41
Denmark	2022-01-06	80.12
Guernsey	2022-01-11	81.01
Canada	2022-02-09	80.05
Seychelles	2022-02-15	80.54
Argentina	2022-02-28	80.02
Qatar	2022-03-03	87.90
Ireland	2022-03-05	80.03
Uruguay	2022-03-09	80.02
Australia	2022-03-11	80.12
Niue	2022-03-13	87.79
Cook Islands	2022-03-14	81.04



**Fig 1.** Comparison of fully vaccinated among G7 countries and Malaysia.

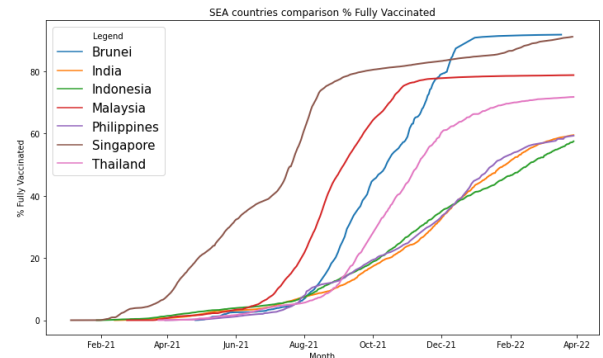


**Fig 2.** Boxplot of Malaysia and G7 countries' people fully vaccinated percentage.

Figure 2 shows the boxplot of Malaysia, and G7 countries' people fully vaccinated percentage. It shows that Malaysia is one of the countries that have a high number of people fully vaccinated per hundred.

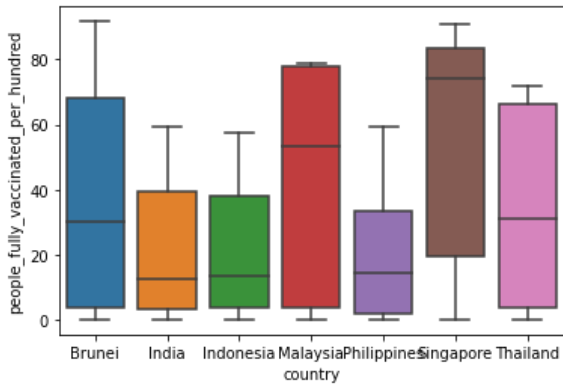
**3.3 Vaccination rates of Malaysia compared with some of the other SEA countries**

Brunei, India, Indonesia, Philippines, Singapore, and Thailand's vaccination rates are compared to Malaysia.



**Fig 3.** Comparison of fully vaccinated among Malaysia and other SEA countries.

As seen in Figure 3, Singapore's vaccination progress was the earliest, followed by Malaysia compared to the other countries stated above. Malaysia's vaccination rate was the highest from July 2021 to October 2021, and the vaccination rate was very low. At the end of March 2022, Brunei had the highest fully vaccinated percentage, followed by Singapore, Malaysia, Thailand, India, Philippines, and Indonesia.



**Fig 4.** Boxplot of Malaysia and some SEA countries' people fully vaccinated percentage.

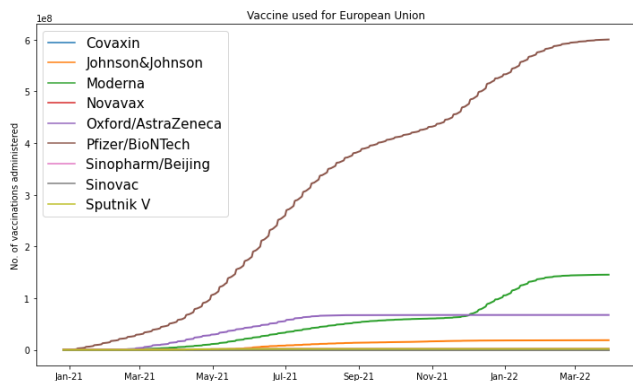
Figure 4 shows the boxplot of Malaysia, and G7 countries' people fully vaccinated percentage. It shows that Malaysia is one of the countries that have a high number of people fully vaccinated per hundred.

3.4 Most popular vaccines

**Table 2.** The fastest countries to reach an 80% vaccination rate

vaccine	date	total_vaccinations
Pfizer/BioNTech	2022-03-30	600519998
Moderna	2022-03-29	210341785
Oxford/AstraZeneca	2022-03-29	67403106
Sinopharm/Beijing	2022-03-29	28322602
Sinovac	2022-03-29	25596927
Sputnik V	2022-03-29	20405678
Johnson&Johnson	2022-03-30	18563903
CanSino	2022-03-29	610540
Novavax	2022-03-29	184429
Covaxin	2022-03-29	11

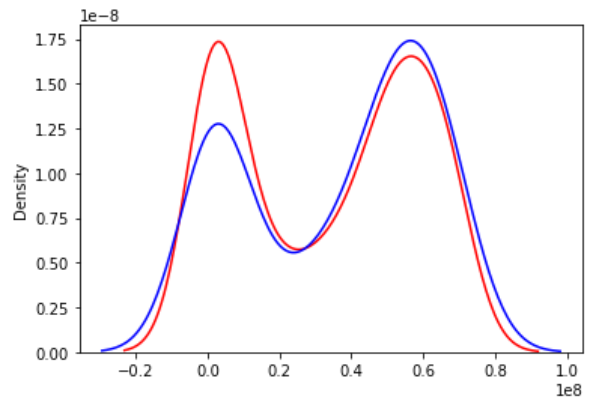
According to the data collected as of 30 March 2022, table 2 shows the most used vaccines. The table indicates that Pfizer/BioNTech is the most prevalent vaccine.



**Fig 5.** Vaccines used in European Union.

It is shown that a wide variety of vaccines have been administered in the European Union. Pfizer is the most administered vaccine in European Union as well. Other Vaccines are administered less than 10%.

3.5 Distribution Plot using actual and predicted data of total Vaccinations in Malaysia



**Fig 6.** Distribution Plot total vaccination in Malaysia.

Figure 6 shows the distribution plot of actual values (red) and predicted values (blue). The plot clearly shows that the predicted value is inaccurate in the first part but much more relative to the actual values in the rest of the plot. The difference reflects what we observe in the real world and is the result of a generalization error. Multiple attributes have been used for the predicted values for the model since it is much closer to actual values.

The R2 value is calculated using the python cross-validation function and finding the score's average. The R2 value for this model is shown in Figure 7.

```
lre=LinearRegression()
RcrossV= cross_val_score(lre, MalaysiaX, Y, cv=3)
RcrossV

array([0.99999988, 0.99999999, 0.99999993])

###R^2 value
np.mean(RcrossV)

0.9999999326760752
```

**Fig 7.** R<sup>2</sup> value.

The model's accuracy is the mean of the accuracy of each fold. The mean, which is also the R<sup>2</sup> value, is 0.999. Hence the accuracy of this model is very high.

4. DISCUSSION

According to [9], only 451,237 individuals, the bulk of whom are frontliners, have received their vaccinations as of 19 April 2021, according to Our World in Data. About 1.2 million doses have already been provided to a total of 275,174 more individuals. (The Pfizer vaccine takes two doses for each individual to get complete immunity.) That amounts to slightly more than 2% of Malaysians receiving at least one dosage overall.

As of May 2021, 1.56 million doses of vaccinations have already been delivered to Malaysia, which indicates that 75 percent of the utilization rate is possible with the doses that have been administered. This is about in line with the US, Europe, and Canada, three major nations that have advanced the most in the spread of vaccinations. However, Malaysia was still unable to achieve more than 80% by the end of March 2022 as Canada did. In other words, the issue is not

with the logistics, administration, distribution, or storage of the vaccine itself but rather with the lack of vaccine availability in the nation. [9]

Therefore, the delay in signing procurement agreements with vaccine manufacturers last year while Malaysia awaited a thorough investigation and verifiable proof of the safety and efficacy of each possible vaccine must be the fundamental problem for the slow vaccination progress of Malaysia. As we now understand, this inactivity comes at a high price. We wound up being well down the vaccination distribution line. One example is Malaysia only signed its first contract with Pfizer on 27 November 2020 for 12.8 million doses [10]. Comparatively, the US and the UK negotiated contracts with Oxford-AstraZeneca in May 2020, while agreements with Novavax, Pfizer, Sanofi-GSK, J&J, and Moderna were reached between June and August of the same year [9]. Even then, some questioned the vaccinations' safety and effectiveness and whether they were the best way to stop the epidemic.

However, based on the data analysis done in the previous section, it is shown that Malaysia is not lagging in vaccination progress compared to other countries. From research, Malaysia has achieved a complete vaccination of 78.72% as of 29 March 2022 which is considered good progress. The Malaysian economy has suffered greatly due to Covid-19 [11]. The harm done to the Malaysian economy has two different sources: The first is an external problem brought on by the effects of the coronavirus overseas, whereas the second is a home one primarily brought on by prior national movement restrictions. Even with a bad economy, Malaysia made good vaccination progress than half of the G7 countries, which have more advanced economies than Malaysia. Furthermore, Malaysia is among the top three with the highest percentage of fully vaccinated people among the SEA countries that have been compared earlier.

Effective public health control plans must start with studying epidemic trends, timeline progression, predictions, and recommendations. AI and data analytics are crucial on the epidemiological, diagnostic, and clinical fronts. [12]. Jupyter notebook was used to generate trend graphs for three of our scenarios to address this problem. JupyterHub, which provides users with a consistent environment without requiring them to install any software on their workstation, makes it easy to provide Jupyter to various users in a business or university. [13] Trend direction offers more precise details on the rate of change in the total number of instances. A trend direction graph provides a more "intuitive" depiction of how case rates change weekly for each location, which may be more significant. [14].

## 5. CONCLUSION

In summary, Malaysia delayed the signing procurement agreements with vaccine manufacturers last year. The reason is to perform a thorough investigation and verifiable proof of the safety and efficacy of each possible vaccine. Hence, this became the fundamental problem for the slow vaccination progress of Malaysia and why the country unable to achieve more than 80% of vaccination rate.

Even though Malaysia's vaccination program started late, Malaysia was one of the countries with a high number of

people fully vaccinated per hundred among the G7 countries and SEA countries.

The application of data science and data analytics has proven valuable in the circumstances like these, where members of the public may observe the graphs produced by the algorithm we wrote to determine if the Covid-19 spread is increasing or decreasing.

The epidemic has shown to be a hindrance in many facets of life, such as social, economic, and religious. Several vaccines against the human coronavirus SARS-CoV-2 have been created using various techniques. Given the difficulties, it's doubtful that the virus that causes COVID-19 will be protected by herd immunity. But the proportion of people who have received all recommended vaccinations is growing. This has undoubtedly reduced the risks of COVID-19.

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