Spread of Covid-19

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Analysis

Since the first Covid-19 case was reported in January 2020, more than 30 variations were found in two years. Of all these variances, Alpha, Beta, Delta takes up most of the diagnosed cases, while the recently reported Omicron variation also shows a possible increased transmissibility [1]. Data shows that break out of a new variance usually means alternating the previous major variance, rather than allowing both of them exist together (figure.1), especially for Delta variance (figure.3).

Worldwide vaccination started mainly in January 2021 (figure.4). By December 2021, more than 50 countries have had over half of their population fully vaccinated. Take the US as an example: we run a linear regression on the number of new cases in the US and its vaccination rate. Results shows that if fully vaccinated rate per hundred population increases by 1, then the numbers of new cases per million should decrease by 2.75, with p.value$<$0.001.

The hypothesis is that countries with higher vaccination rate should have few new cases. We run a linear regression on the relationship between the number of new cases per million and the number of people fully vaccinated per hundred, based on the data for December 17th, 2021 for all countries. Although we got a p.value equals to 2.87e-05$<$0.001, the gradient is 6.498$>$0 (table.1), which means, although the vaccination rate kept increasing, it did not sufficiently limit the infection of Covid-19.

We then look back into the specific case of the United States. We notice that there is a sudden increase of new cases (figure.5) when vaccination rate reaches 45%. Compare this plot to figure.4, we know that it is around June 15th 2021, which is also the time that Delta variant broke out. Similar pattern shows up for the UK and India. Possible explanation is that vaccination is not effective in limiting the spread of "Delta" variant. If we compare the increase rate of each variant in figure.3, we could tell that the speed that Alpha and Delta cases increases are almost the same, usually reaching the maximum value three months after break out (not all countries are shown here, but most of them shows similar pattern). By December 17th, the increase of Omicron Variant also shows similar trend to the previous Alpha and Delta ones, and it is quite possible that by February, Omicron will take up to 90%-100% of new cases in most countries, given all existing vaccines show little effectiveness to protect people from infected with Omicron according to recent studies [2].

Dataset

The "covid.csv" dataset is collected from WHO, ranging from 2020-01-01 to 2021-12-20 including all countries, with 163324 observations in total. https://ourworldindata.org/coronavirus

The "variants.csv" datset is collected from https://www.kaggle.com/datasets/gpreda/covid19-variants

Reference

1. Risk assessment for SARS-CoV-2 variant Omicron (PDF) (Assessment). Public Health England. 9 December 2021. GOV-10654. Retrieved 10 December 2021. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1040064/9_December-2021-risk-

assessment-for-SARS_Omicron_VOC-21NOV-01_B.1.1.529.pdf

2. Annika Rössler et. al, SARS-CoV-2 B.1.1.529 variant (Omicron) evades neutralization by sera from vaccinated and convalescent individuals. 11 December 2021. doi: https://doi.org/10.1101/2021.12.08.21267491