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COMP5048 Assignment 2 – Group report

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I. INTRODUCTION

Since the end of 2019, a global Covid-19 pandemic has widely affected people's way of living and working. According to the Health department of Australia government, the first Australian coronavirus infection case was confirmed on 25 Jan 2020 [1]. Between 2020 and 2021, there were two major COVID-19 outbreaks in NSW. Over these two years, the New South Wales government implemented several policies and regulations to stop the spread of the Covid-19 which included: enforcing good hygienic processes, encouraging Covid-19 testing, travel and gathering restriction, and encouraging vaccination. The content below will discuss these 4 strategies and their effectiveness and find out the most effective strategy or combination of strategies.

II. ENFORCING GOOD HYGIENIC PROCESS

A. Data description:

The data which is utilised in the visualisation below is the daily new cases in NSW from 26 Jan 2020 to 31 Mar 2020. A colour technic will be used to divide the data before and after good hygienic process strategy was applied.

B. Axis arrangement and Visual variables

In this diagram, the trend of Covid spreading before and after applied good hygienic process is expected to be delivered to the audience. To demonstrate the trend of cases changing by each day, a line chart is selected as the framework. In this line chart, sorted dates which is an ordinal data is arranged on x-axis and number of cases for each day which is a ratio variable is arranged as y-axis. To focus on good hygienic strategy only, x-axis range is set as between 26 Jan 2020 and 31 Mar 2020 before further regulation released. For providing a better observation of the effect of this strategy, the data before and after applied good hygienic process will be separated by different colour (pink and blue).

C. Effectiveness analysis

Good hygienic procedures policy was released by the New South Wales government on 4 March 2020, it urged local communities and individuals to help prevent coronavirus by applying good hygienic procedures [2]. Good hygienic procedures include several practices such as: washing hands regularly, using alcohol sanitiser frequently, wearing surgical masks, etc. Good hygienic procedures policy was operated isolated from 4 March 2020 to mid-March 2020 before further covid related policies were released. The data visualisation of

daily reported Covid-19 cases in NSW between 26 January 2020 to 31 March 2020 is shown below:

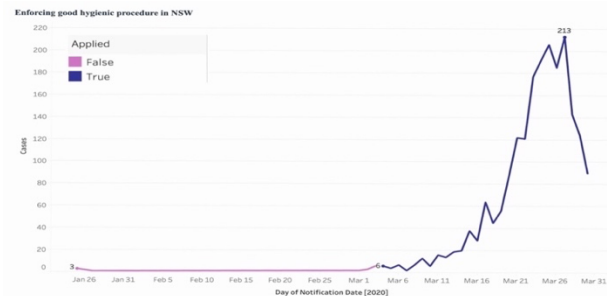


Fig 1: the effectiveness of good hygienic procedure in NSW

In Fig 1, the pink line is the Covid-19 infection cases trend before applying good hygienic processes policy in NSW, the blue line is the Covid-19 infection cases trend after applying good hygienic processes policy in NSW. By observing the visualisation above, it is obvious to see that there is a major outbreak of coronavirus spreading in New South Wales immediately after the implementation of good hygienic procedure policy. The first outbreak started around 11 March 2020 with an exponential growth and reached its peak at 213 new cases on 26 March 2020. According to McAloon's research, the incubation period of coronavirus is about 10 to 11 days [4], it means that the patients of Covid-19 cases on 26 March were infected between 16 March and 17 March which is also after the good hygiene policy released in NSW. Hence, it is clear to summarize that good hygiene policy did not prevent the spreading of coronavirus in NSW successfully.

D. Gap between anticipated and actual impact

According to Tan's research, enforcing good hygienic process is expected to flatten the increase of new local Covid-19 cases. However, between 6 March 2020 to 26 March 2020, Covid-19 cases in NSW growing rapidly from 6 cases to 213 cases at the peak after good hygienic process is enforced in NSW. It is obviously to conclude that the expectation is not met by applying this strategy in NSW and the gap between expectation impact and actual impact is huge. The potential reason of this disappointment could be practicing good hygienic processes is difficult to be strictly followed and properly monitored for individuals. Based on the analysis above, it is appropriate to summarize that applying good hygienic procedures is not an effective method and failed to control the spread of Covid-19 virus in NSW.

III. ENCOURAGE TESTING

A. Data description:

The data selected for the analysis of the impact of testing incentives on the outbreak was the cleaned official NSW confirmed Covid-19 infection cases data in 2020 and 2021.

B. Axis arrangement and Visual variables

Two graphs namely Fig 2 and Fig 3 will be created for effectiveness analysis for encourage testing strategy and provide understandable information to the readers. In Fig [2], the x-axis will be the individual months in 2020 which is an ordinal variable. The y-axis will be the number of infection cases and Covid-19 testing numbers for each month which are both ratio data. A coloured multiple line chart will be used to visualise trends of tests and cases over time. The use of coloured lines with orange and brown dashes could clearly separates these trends based on different variables. In Fig 3, coloured line chart will be used to demonstrate the trend of Covid-19 cases and Covid-19 testing in NSW. Similar with Fig 2, months will be located on x-axis. Testing number and infection cases number will be located on y-axis and separated by different colour.

C. Effectiveness analysis

Encourage Covid-19 testing policy was released from early days and promoted by NSW government. At this stage of epidemic, testing is an integral part of patient detection, treatment, and recovery. According to the NSW government [5], Ms. Berejiklian indicated that COVID-19 testing will increase from about 4,000 to 8,000 times a day because of the need to control the spread of the epidemic. The government is urging anyone with COVID-19 symptoms to get tested for coronavirus. Base on the research above, the analysis on encourage testing will first select regional testing data for 2020 [6] and monthly data on the number of confirmations and deaths [7] to examine the impact of encouraging testing on COVID-19 transmission.

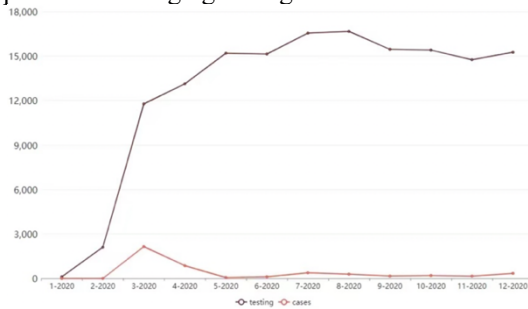


Fig 2: effectiveness of encouraging testing in 2020

As can be seen from the fig 2, the COVID-19 epidemic began to spread widely in Australia in March 2020 and was temporarily mitigated in May of that year. The trend in the number of surveillance sites is inversely proportional to the number of confirmed cases. That is, as the number of surveillance sites increased, the number of confirmed cases decreased. And subsequently, because of the previous experience of epidemic prevention, the number of testings is in a stable range and the number of confirmed cases is also in a stable range since the decrease. Therefore, from the above

graphs and summaries, it can be tentatively concluded that the strategy of encouraging testing contributes to the epidemic transmission in the whole society. The diagram which demonstrates the trend of testing numbers and Covid-19 infection cases in 2021 is shown below:

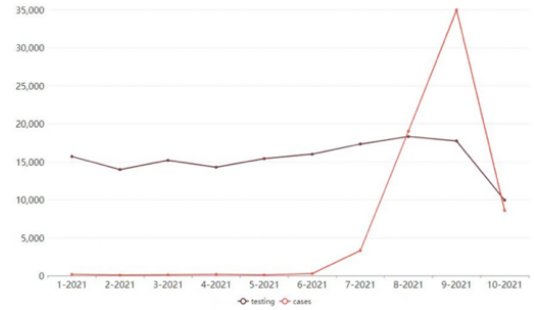


Fig 3: effectiveness of encouraging testing in 2021

Fig 3 above shows that there is a sudden increase in the number of cases in June and an increase in the number of tests, and an increase in the number of tests from July to September, and an increase in the number of cases, without the inverse relationship of last year. Thus, it suggests that the number of tests is not the most important effect on the spread of new crowns. However, in October, when vaccine coverage reached 50%, the number of confirmed cases dropped significantly, which will be discussed in detail later in the report.

D. Gap between anticipated and actual impact

According to study of OECD [13], abundant testing and tracking is expected to control local Covid-19 outbreak. Base on the analysis above, testing might controlled Covid-19 outbreak from March 2020 to June 2021, however the major outbreak which started from June 2021 was not effectively controlled by testing. This means, encourage testing might not the most efficient way for suppressing local pandemic in NSW.

IV. TRAVEL AND GATHERING RESTRICTION

A. Data description:

The dataset selected for this analysis was the cleaned official NSW confirmed cases data from beginning of 2020 to October 2021.

B. Axis arrangement and Visual variables

The visualisation that supports this analysis is line charts that show the trend of case numbers in NSW throughout the designated period. The trend of daily cases provides an intuitive message of how NSW society benefits or suffers from the Covid situation in a time series manner. In Fig 4 and Fig 5, two coloured line plot will be created using data from February 2020 to May 2020 and June 2021 to October 2021 respectively. Date will be arranged as x-axis since its an ordinal variable and cases which is ratio variable will be arranged as y-axis. Colouring (Red and Blue) will be used to separate the restriction period and non-restriction period and bring a better comparison analysis. Furthermore, there will also be a clear text annotation in the graph that indicates when the restriction starts, providing a better perception for the audience.

C. Effectiveness analysis

Australia has implemented the international travel ban since 20 March 2020. It was because the Covid situation started to gradually spread over the country. According to ABC News [9], implementing a lockdown strategy protects the society on a health and social level. Following analysis will discuss how the closure of the international border and the NSW lockdown affect the society at the health level (essentially the case number). The line chart which demonstrates the cases number in NSW from beginning of March 2020 to May 2020 where international border closed in this period is shown below:

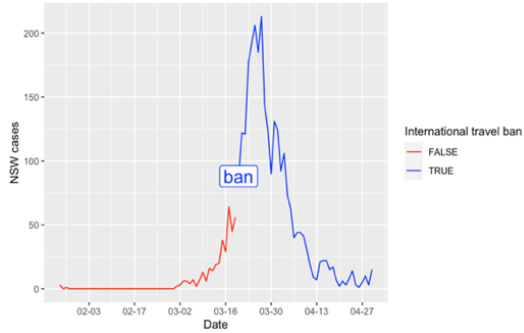


Fig 4: NSW cases vs Date (for international travel ban within one month)

The analysis captures the period at a closer horizon as shown in figure 4. The ban started from 20 March 2020 and the process is to select an observation point 14 days after the announcement. During the 14-day period, the number of daily cases rises initially, but falls afterwards. This confirms the validity of the international travel ban as the number falls. Moreover, it is evident that after the 14-day period, the number continues to fall. It emphasises the effectiveness of implementing the international travel ban to stop the spread from overseas sources of infection. The diagram which demonstrates the cases number in NSW from beginning of June 2021 to October 2021 where NSW border closed in this period is shown below:

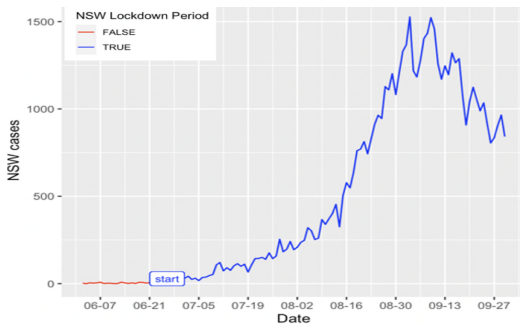


Fig 5: NSW cases vs Date partial data (for NSW lockdown period within a few months)

In June 2021, to respond to the rapid spread of the delta wave, the NSW government implemented a state-wide lockdown starting from 26th June 2021 and the lockdown has ended since 11th October 2021. Specific restrictions include a ban from travelling outside a 5km range from the residential address, a ban from unnecessary outdoor activities and also a ban from

people contact with others not from the same address. A similar approach is applied as the previous part to observe the trend after the lockdown start day. However, from figure 6, a rising trend is observed for the case numbers. The rising trend does not turn back until the very late stage of the lockdown period, where the vaccination rate rises to a significant level (discussed later in the report).

D. Gap between anticipated and actual impact

According to Atalan [14], travel restriction and gathering limitations theoretically could prevent the local pandemic from happening. However, according to the analysis in this section, travel and gathering restriction failed to control the Delta wave in 2021. Hence, Lockdown could be considered as a relatively weak strategy to stress the pandemic. The potential reason could be the lockdown restriction might not be strictly followed by the residents in NSW. Also, necessary international logistics and international flight which bring Australian citizens back to their home could potentially carry the virus.

V. ENCOURAGING VACCINATION

A. Data description:

Data in the visualization below will include the number of vaccinations in NSW from 2021/4/27 to 2021/10/15 [12] and the number of new confirmed cases in NSW from 2021/4/27 to 2021/10/15.

B. Axis arrangement and Visual variables

The date is ordinal data, so it was designed as the horizontal axis. Also, after discussion, we decided to use time as the horizontal axis to connect visualization of different strategies so that users can compare them easily. Although the magnitudes of the number of new cases and percentage of vaccination in NSW are different, the tendency of their change is the same which means the value of them increases from the bottom of the vertical axis to the top of the axis. Therefore, two different vertical axes were designed, the left one is for new confirmed cases, and the right is to express the percentage of vaccinations (how many people are vaccinated) in NSW. The line chart is used as the visualization because the Line chart can clearly show the change of number and the tendency of change according to the lecture slide [8]. Also, because the data types are 'quantity', the line chart can express 'quantity' data effectively. Two colours are used to distinguish different data clearly. The red line to show vaccination proportion and blue line to show new cases. Finally, notations are used to point out two important dates which can get users attention and convey the content of visualization directly.

C. Effectiveness analysis

Australia will be open to public vaccination from January 21, 2021. Vaccines work by inactivating the COVID-19 virus, or by other means, making the body produce antibodies to the virus. In this way, antibodies can be generated in a timely and effective manner to prevent discomfort in the human body and kill the invading virus when attacked by the COVID-19 virus, thus reducing the transmission of the virus through the viral load in droplets due to virus replication in the body after

producing symptoms. Related data visualisation is shown below:

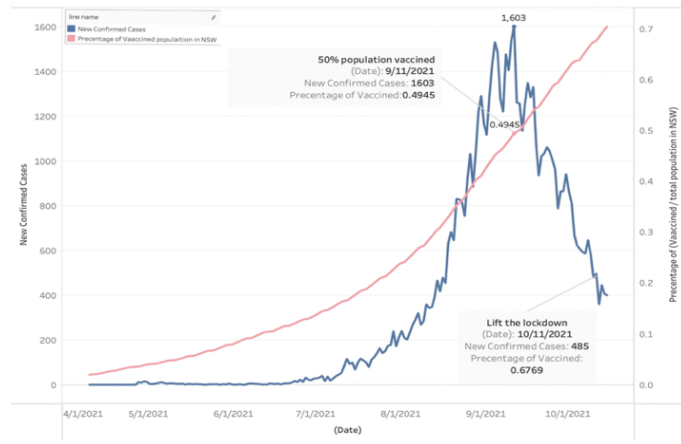


Fig 6: effectiveness of vaccination

By visualizing the number of vaccinated people as a percentage of the total NSW population with the number of new NSW diagnoses, several data points were quite surprising in this visualization alone. Several points will be discussing below.

From June to August, the number of newly confirmed in NSW increased rapidly and reached a peak due to the Delta COVID-19 virus into Australia, and the proportion of vaccinated people in NSW was only about 20%. According to some papers, the effect of the vaccine on the spread of the virus becomes apparent when at least more than 50% of residents in NSW are vaccinated. According to Fig 5, vaccination rates jumped by 40% between mid-July and mid-September, and soon 50%. Coincidentally, when the number of new cases peaked, the proportion of vaccinations achieved 50%. Therefore, this is an interesting data point to express whether the vaccine is effective to control the spread of the virus. In Fig 6, only three days after the vaccination rate exceeded 50%, the surprising thing was that the number of newly confirmed cases in NSW dropped significantly. Although admittedly there was a slight increase, the overall tendency was in a downward phase. At the same time, vaccination rates were increasing rapidly.

In addition, the lockdown was lifted on 10/11/21 and, simultaneously, the vaccination rates approached 70%. People generally don't wear masks at gathering activities, such as parties, doing exercises and having dinners. However, there were not many rebound cases caused by the lift of lockdown. It can therefore be argued that vaccines are effective in controlling the spread of COVID-19, but only when at least 50% of a region's population is vaccinated.

D. Gap between anticipated and actual impact

According to the research [10] and [11], before encouraging people to get vaccinations, the government and some researchers believe that vaccination will reduce the spread of COVID-19. However, it also indicated that researchers are not certain about the effectiveness on vaccination. As shown in Fig 5, although the effectiveness is not obvious when the vaccination population is low, the vaccine showed its power after the number of vaccinations beyond 50% population in

NSW. Therefore, encouraging vaccination has reached the expectation of the governments and citizens.

VI. STRATEGIES COMPARATION

The above theoretical analysis was applied on each strategy. The purpose of following two visualizations is to compare the effectiveness between these strategies and find out the most efficient strategy or combination of strategies. The following diagrams namely Fig 7 and Fig 8 will compare all strategies or combined strategies which were applied by NSW government between 2020 and 2021. The combination of area chart and line chart will be used to show those data for further analysis. In the following diagrams, the date is arranged as horizontal axis which is time series ordinal data. The vertical axis is arranged as the number of new confirmed cases, number of testing, and new vaccinated residents for each day which are all numeric ratio data. To represent various period with different strategy or combination of strategy, 4 colours are allocated to each strategy activation period. More specifically, blue area represents the period after good hygienic process is enforced in NSW from the beginning of 2020 to 21 March 2020. Yellow area represents the period after international border closed. The red area represents the period after encouraging vaccination policy was released in NSW. The darker green line in the first diagram represents the testing numbers for each day. In the second diagram, the green line will represent the number of fully vaccinated NSW residents by each day. Fig 7 and Fig 8 will be created with same range of axis so that the audience could compare these diagrams more easily. Related diagrams are shown below:

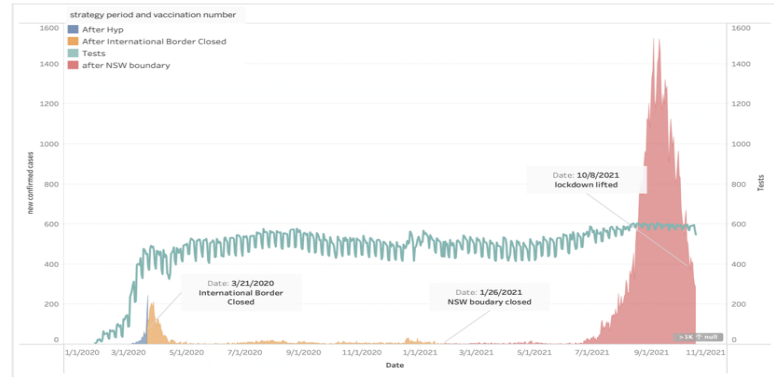


Fig 7: effectiveness comparison of good hygiene, testing and travel restriction

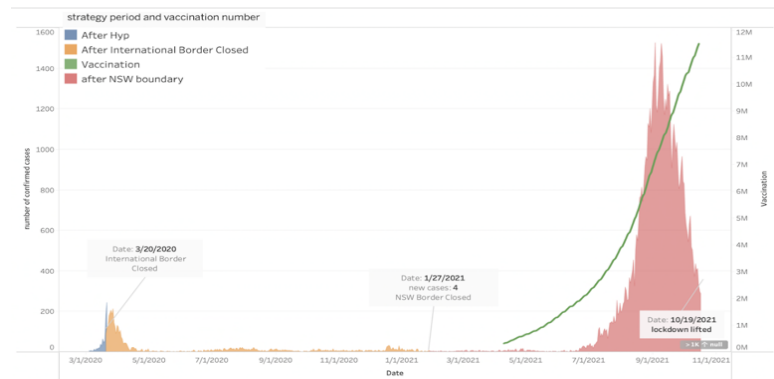


Fig 8: effectiveness comparison of good hygiene travel restriction and vaccination

According to the diagram above, it is obvious to see that there were 2 major outbreaks of coronavirus in NSW from 2020 to 2021. The second major outbreak has a larger spreading scale and speed because the Delta coronavirus that was circulating at the 2021 was much more contagious than coronavirus. In Fig 6, around mid of March 2020, the blue area kept increasing till the yellow area, which means the good hygiene policy fail to control the first covid-19 pandemic while travel restriction successfully control the first outbreak in NSW. Hence, travel restriction is more valid to stress the Covid pandemic in NSW than enforcing good hygienic process. Around late March 2020, encouraging testing policy was released, it stabled the covid outbreak from May 2020 to mid 2021. In 27 Jan 2021, NSW boundary was closed which is a more restricted travel regulation than closing international border. However, a more serious Delta coronavirus outbreak happened in the middle of 2021. By observing the trend from Fig 6, travel restriction and encourage testing policy both failed to control the second Delta Covid-19 outbreak.

In Fig 11, the encouraging vaccination policy started around May 2021, before September 2021, the vaccination policy seems failed to control the spreading of the second outbreak. However, with the growing number of vaccinated residents in NSW. The number of delta infection cases decreased dramatically after September 2021. Hence, encouraging vaccination started to control the spreading of Delta coronavirus outbreak. That means, vaccination controlled the major outbreak which other strategies failed to control. As a result, vaccination could reasonably get verified as the most effective individual strategy.

However, with a more comprehensive analysis based on the real situation happened around September 2021 when number of cases started to drop heavily, encouraging vaccination is applied while enforcing good hygiene and encouraging testing policies are still valid and activated. Hence, encouraging vaccination might not be considered as the only reason for successfully controlling the second major outbreak. A more specific judgement should be the combination of encouraging vaccination, encouraging testing, and enforcing good hygienic procedure strategies produce the best result for controlling a more threatening major outbreak of Delta coronavirus.

VII. CONCLUSION

Overall, the most efficient individual strategy so far is the encouraging vaccination strategy. From the analysis and observation in this report, enforcing good hygienic processes was feeble since it did not stop the first covid outbreak in early 2020. Encouraging testing did decrease the first covid outbreak in 2020 but fail to control the second major delta covid outbreak in 2021. The performance of travel restriction did not meet the expectation to stop the spread in outbreak in 2021. Vaccination policy was applied in later 2021 and controlled the more threatening delta coronavirus from further spreading. However, when vaccination policy was activated, good hygiene and

testing policy are still valid. Hence, the combination of enforcing good hygiene, encouraging testing, and encouraging vaccination strategy provided the best performance to control the Covid-19 pandemic in NSW.

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