

# Policy Proposal for the Post-COVID Era in Korea: Based on the Data Science Analysis of the Quarantine Model Countries and the With-COVID Implementing Countries

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## Abstract:

We would like to propose policies based on data science analysis of the quarantine model countries and the countries implementing with COVID-19 to prepare for the post-Corona era in the future. Three countries, Taiwan, New Zealand, and Australia were selected as quarantine model countries and analyzed whether there are interesting policies that can be benchmarked in Korea among their policies. Three countries, Denmark, the UK, and Singapore were also selected as countries that implemented with COVID-19, and the conditions they met before the implementation and the results after that were analyzed. Through the analysis of the quarantine model countries, we argue that it is very necessary to establish a systematic response manual for infectious disease mutations, establish education and welfare policies according to the severity of the spread, and strict punishment for violators of quarantine rules. In addition, through the analysis of the with COVID-19 implementing countries, we confirmed vaccination rate and death rate, etc. and it was found that Korea was under relatively stable conditions to implement it. We also argue that sufficient medical accommodation should be established to cope with the increasing number of patients.

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## I. Introduction

### 1. Research Background & Purpose

#### (1) The Prolonged COVID-19 Outbreak

About two years have already passed since the emergence of COVID-19, but rather than leaving us, the spread has rather intensified recently. We have been so disturbed that it is difficult to recall the situation before COVID-19, and everything that we took for granted is now precious. The unexpectedly prolonged situation has hurt self-employed people too badly, especially. Now, we can't even see busking performances that fill the empty streets. All elementary, middle, and high school students should always be nervous about the occurrence of confirmed cases on school, and when confirmed cases occur, they do not go to school and take classes in the form of online classes at home. Although the situation of universities given relatively autonomous management rights is different, most universities also conduct non-face-to-face classes. Everyone covers their faces with masks and sometimes they are ashamed and afraid of

the moment when they take off their masks and show their faces when they meet new people. Just with a someone's slight cough and sneeze, people feel a sense of avoidance and try to stay away from him or her. Of course, acknowledging that this situation is now inevitable and unstoppable, more and more people claim symbiosis with COVID, which is called 'with-COVID'.

#### (2) The Lessons Learned from COVID-19

It is clear that we are still living in the COVID-19 era, and it is not yet known when it will end or whether we should live together like the flu. However, COVID-19 has raised awareness around the world about coping with infectious diseases. It allowed some countries to self-check whether they lacked a medical system or an economic or welfare policy system. It is not strange to say that a new epidemic emerges after leaving COVID-19. We should take lessons from the COVID-19 era to develop a 'national immunity' to infectious diseases. Especially, it is necessary to accurately judge what needs to be supplemented in policy and respond appropriately to future infectious diseases. We desperately felt how tired and difficult the impossibility of daily life was, and how great the

importance of that daily life was. This situation should not be repeated again. Therefore, it is necessary to pay attention to the policies of quarantine model countries that are considered to have shown excellent quarantine in the early stages of the COVID-19 outbreak. Of course, there will be differences in geographic, political, and economic environments by country, but we will examine whether Korea can benchmark or apply the excellent policies they have shown to us.

### (3) The Birth of the Word 'With-COVID'

As more and more people and scholars have acknowledged that the prolonged situation cannot be stopped and controlled, more countries have declared 'With-COVID,' which means symbiosis with COVID, not 'COVID Out.' This is aimed at eliminating restrictions on social distancing and returning to daily life. They said because vaccinations have not shown perfect effectiveness to persistent virus mutations, and the development of perfect medical treatments has been delayed, causing fatigue in daily life to people around the impossibility of daily life.

Korea also switched to the With-COVID system from November. While there are positive reactions from the public in anticipation that it will be possible to return to daily life, there are also negative reactions based on the government's insufficient response to cases of vaccine side effects and the still high number of confirmed cases. It is still too early to determine whether the successful transition to With-COVID will be possible or impossible. So, we would like to analyze the countries that implemented With-COVID earlier than Korea to find the answer whether Korea has the conditions for converting to With-COVID and what should be prepared for the successful transition to it.

## 2. Research Methods

### (1) Analyzing Quarantine Model Countries

We have two big directions on our research. The first direction is the policy analysis of the quarantine model countries, and the second direction is the policy analysis of the countries that implemented with-COVID earlier than Korea.

We selected three countries for the quarantine model countries: Taiwan, New Zealand, and Australia.

Regarding the policy analysis of the quarantine model countries, we had the following questions. What policies have shown their remarkable quarantine performances? What policies can be benchmarked to prepare for the post-COVID era? What made the response more appropriate than Korea? Is there any interesting policy that can be applied to Korea?

We produced the increase rate of recent 30 days confirmed cases compared to the previous 30 days through Python. We tried to analyze the quarantine results of the countries from a long-term perspective. This is because I thought the long-term perspective is necessary to deal with the sudden increase like outlier values and missing null values. We also thought that it is necessary to watch the effect of the policies. This can solve the limitations of simply analyzing the daily number of confirmed cases collected every day. Through this analysis, we tried to show how good the quarantine model countries have actually shown, and whether there is a common time when even those called the quarantine model countries have failed to quarantine and learn lessons from it. Detailed policy analysis was conducted by each country. We investigated their response policies respectively using previous studies of other researchers, studies similar to ours, columns, and policy reports. Among the policies, it was analyzed whether there are any notable policies and policies that can be applied to Korea and can be a lesson.

### (2) Analyzing Implementing With-COVID Countries

We selected three countries for the implementing With-COVID countries: Denmark, the United Kingdom, and Singapore. Regarding the analysis of the implementing With-COVID countries, we also had the following questions. What was the conditions to start with-COVID, such as the death rate and the vaccination rate? To what extent is it consistent with the situation in November in Korea that begins with-COVID. What are the lessons learned from the countries that implemented with-COVID earlier than Korea?

The second point of our work is the study of the post-covid era and more particularly about how it will end. Indeed, at the end, the goal of every country in the world is to get back to the life before the covid the fastest possible. This second part will discuss the

return to the “normal life”, with the switch to the with-corona policy in Korea.

What we call the with-corona policy is when a country decide that the pandemic isn't a threat to the life of their citizens anymore, and that the social distancing rules and different policies are abolished. All those changes don't necessarily need to happen in one day, so we studied the progressive switch to the life with the Coronavirus.

Therefore, to be able to tell from when this switch is possible, we decided to look at countries that had already implemented this policy to see how the situation evolved from the moment the switch happened [14, 15, 16]. We choose those three countries because they have different population types, with different density and culture in order to cover a larger possibility of cases. We are looking to find what are the necessary conditions to be able to make that switch, and if Korea is meeting those conditions.

We used a mix of Python and RStudio to process the data we found about those countries and looked at multiple indicators to follow the evolution of the pandemic. Our analysis focused on comparing the number of new cases, death rates, vaccination rates, and the ICU patients rates. In addition, we produced the hospital urgency indicator that can show admissions in the hospitals.

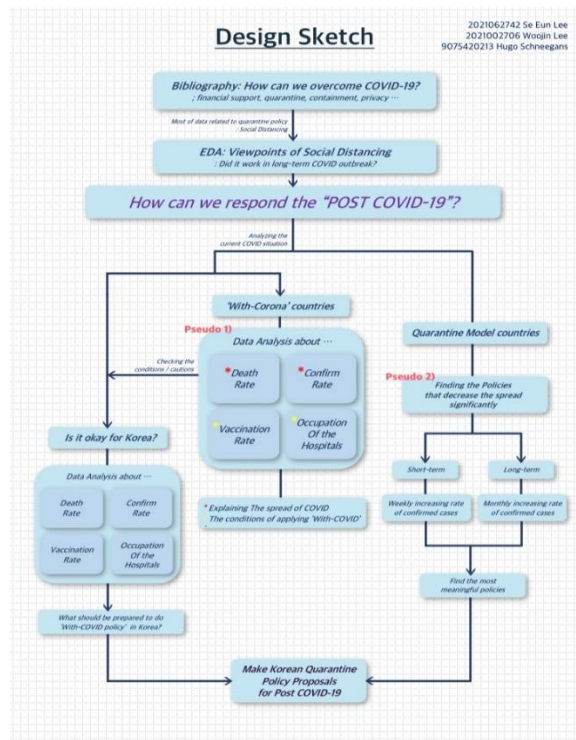


Fig 1. Design Sketch of Our Research

## II. Literature Review

We were able to refer to various studies, articles, and columns through bibliography process. We did our bibliography with keywords such as economic recession, medical/health, and politics centered on COVID-19. About 30 were referenced, and we would like to select and introduce six of them that were directly connected or deeply related to the actual setting of our research topic.

### 1. Research That Helped Set the Topic and Direction of Our Research

#### (1) 코로나-19 4 차 대유행 위기와 과제

This policy proposal column predicts the fourth pandemic in April 2021, before the fourth pandemic of COVID-19 in Korea and deals with policies that can respond to actual situations. While emphasizing that it has been coping with the crisis with the active participation of the people, it is criticizing the reality of herd immunity and the quarantine rules that cause people's fatigue. The author of this column argued that the facilities such as saunas and sports gyms with low access to quarantine monitoring should be intensively disinfected and guided on quarantine rules. They also argued that the government should actively utilize industrial nurses to manage infection at office workers, and finally, it is necessary to develop and distribute apps for vaccination and tracking the movement of the confirmed [1].

The research method in this column is completely consistent with the overall direction of our study. It helped us to get ideas in terms of research methods. This led us to analyze which policies in a particular country were most inefficient and most vulnerable, so that they needed to be supplemented. It also led to a look at whether there are policies that we need to improve and introduce in order to prepare for the post-COVID-19 era.

#### (2) Containment Strategies for COVID-19 Pandemic

This document answers the question: How do different countries responded to the Covid-19

pandemic? and displays several containment strategies (permissive, restrictive, and hybride) of the PCS model (Pandemic Containment Strategy). The three strategies level plays on the different containment dimensions (p.8), with Restrictive being very strict about the freedom, Permissive being easier, and Hybride being between the first two. The studies of Bob Travica aim to see if it is possible to create a particular model of containment based on what each country did. His studies have been limited to several Asian countries at the center of the epidemic, Western Europe and North America [2].

This study played the most decisive role in adopting our comparative analysis of COVID-19 response policies shown by countries around the world as a research method. This study made us think that in order to criticize Korea's policies, we should compare them with other countries' good policies. This study also provided an opportunity to think about whether we could introduce ideal and efficient policies into Korea. Based on these, it was possible to conclude policy proposals from various aspects to the Korean government.

## **2. Research That Helped Determine the Contents of Our Research**

### **(1) Modeling of COVID-19 Vaccination Strategies and Herd Immunity, in Scenarios of Limited and Full Vaccine Supply in NSW, Australia**

In this document, the authors aim to present the different vaccination strategies existing and to determine which one is the most efficient. They used a deterministic mathematical model of epidemic response with limited supply to do so, because once the vaccine is available, it is only in a small quantity, so the doses have to be used wisely. They made a simulation with an initial restricted number of doses for 1 million people in Australia and concluded in all the scenarios that 1 million was not nearly enough to contain the progression of the pandemic. Targeting the younger age people for the vaccine will have more impact on reducing the number of cases but targeting the 65+ aged people will have more impact on reducing the number of deaths. Herd immunity is obtainable with a 90% efficacy vaccine on 66% of the population, so the mass vaccination strategy requires

a lot of vaccine doses to work. But once the vaccine supply is available, the quicker a high uptake can be achieved, the greater is the impact on epidemic control, morbidity, and mortality [3].

The vaccine-related discoveries concluded in this research played a decisive role in our attempt to derive insights using vaccine indicators. Through this study, we realized that the utilization and importance of vaccination rate indicators were significant and referred to when analyzing the countries that implemented with-COVID. Furthermore, we came to think about the limitations of vaccination to new mutants and helped point out that the Korean government's response to the side effects of vaccination is very insufficient.

### **(2) The Global Impact of the Coronavirus Pandemic**

This document displays an overall abstract of what the Covid-19 pandemic is, and especially several of its impacts. In this study, the author is only talking about Europe and the United States, but similar consequences might also be visible in the rest of the world. The author addresses the economic impact of the crisis, caused by the different pandemic containment measures, as well as the psychological impact on the populations. Finally, he talks about a beneficial environmental impact, due to the decrease of Humanity's activity and pollution [4].

This study taught us that we would not be able to derive interesting insights simply by analyzing fragmentary indicators such as the number of confirmed cases. Referring to this study, we realized the need for a multifaceted approach to the spread of COVID-19. This served as an opportunity for us to look back into the spread of the quarantine model countries in the long-term perspective, and to consider various indicators of with-COVID implementation countries in combination.

### **(3) COVID-19: Were Public Health Interventions and the Disclosure of Patients' Contact History Effective in Upholding Social Distancing? Evidence from South Korea**

This document analyzes whether social distancing in Korea was effective in preventing COVID-19. The government established a policy called social distancing, saying, "We cannot accurately track the

transmission path of COVID-19, but it is better not to contact them because they are mainly infected with droplets similar to colds." This shows the analysis results of the infection rate/transmission rate before and after the implementation of the policy implemented to see if this policy works [5].

It was an opportunity to reconsider the effectiveness of the distancing policy, which was Korea's most major policy. We looked into the period after the period covered by this article to see if the distancing policy really worked well. The EDA work dealt more deeply with the effectiveness of the current distancing policy. We felt that the effectiveness of the current policy was decreasing. So we thought new policies and other supplementary policies were needed and should be proposed, leading us to determine our research topic finally.

### III. Data Description

#### 1. Data We Have Collected and Used

The data we used for our project comes from Our World In Data (<https://ourworldindata.org/>). We collected a lot of data about the Coronavirus pandemic all around the world and decided to study the case of 7 precise countries (the quarantine model countries, the implementing with-COVID countries, and Korea). The quarantine model countries are Taiwan, New Zealand, and Australia, and the implementing with-COVID countries are Denmark, the United Kingdom, and Singapore. Therefore, we made an excel file with the data of those countries plus South Korea. Our data is sorted rows by country and by date, which means we will have at first all the dates for the first country, then all the dates for the second. And sorted in columns by different indicators.

	A	B	C	D	E	F	G	H	I	J	K	L
1	iso_code	continent	location	date	total_cases	new_cases	new_cases	total_deaths	new_deaths	new_deaths	total_cases	new_cases
2	DNK	Europe	Denmark	14/03/2022	838	32	116	1	1	0.143	143.808	5.505
3	DNK	Europe	Denmark	15/03/2022	875	39	119.714	2	1	0.286	150.517	6.709
4	DNK	Europe	Denmark	16/03/2022	993	58	120.143	2	1	0.429	160.494	9.977
5	DNK	Europe	Denmark	17/03/2022	1025	92	108.714	4	1	0.571	176.32	15.826
6	DNK	Europe	Denmark	18/03/2022	1116	91	96	4	0	0.571	191.974	15.654
7	DNK	Europe	Denmark	19/03/2022	1225	109	86.857	6	2	0.857	210.724	18.75
8	DNK	Europe	Denmark	20/03/2022	1337	112	76.143	9	3	1.286	229.99	19.266
9	DNK	Europe	Denmark	21/03/2022	1420	83	83.429	13	4	1.714	244.267	14.278
10	DNK	Europe	Denmark	22/03/2022	1514	94	91.286	13	0	1.571	260.437	16.17

Fig 2. An Example Data Table of Denmark

We initially had more than 50 columns and needed to make selections to keep only the columns we were interested in. We kept 20 columns as follows.

a	Location	The geographical name of the country or the region
b	Date	The date of observation of the values obtained
c	Total_cases	The total confirmed cases of Covid-19 (crescent)
d	New_cases	The new confirmed cases of Covid-19 each day (variable)
e	Total_deaths	The total of confirmed deaths attributed to the Covid-19 (crescent)
f	New_deaths	The newly confirmed deaths attributed to the Covid-19 each day (variable)
g	total_cases_per_million	The total confirmed number of cases per 1.000.000 people
h	new_cases_per_million	The new confirmed cases each day per 1.000.000 people
i	total_deaths_per_million	The total confirmed deaths attributed to the Covid-19 per 1.000.000
j	new_deaths_per_million	The new confirmed deaths each day per 1.000.000 people
k	reproduction_rate	Real-time estimate of the Reproduction Rate R of the Covid-19. The reproduction rate is the number of people one person that already has the Covid will contaminate on average
l	icu_patients	The number of people in the Intensive Care Unit (ICU) each day
m	icu_patients_per_million	The number of people in the Intensive Care Unit (ICU) each day per 1.000.000 people
n	hosp_patients	The number of people in the hospital each day
o	hosp_patients_per_million	The number of people in the hospital each day per 1.000.000 people
p	people_fully_vaccinated	The number of people who received all the doses prescribed in the vaccination protocol
q	people_fully_vaccinated_per_hundred	The number of people who received all the doses prescribed in the vaccination protocol per 1.000.000 people
r	stringency_index	This is a feature engineering index composed of 9 response indicators like school closure, workplace closure, travel bans... It measures how strict is life because of the restrictions due to the Covid-19 pandemic, on a scale from 0 to 100.
s	Population	The population of the different countries in 2020
t	hospital_beds_per_thousand	The number of beds available in each country per 1000 habitants, from the most recent year available

Table 1. Explanations of Selected 20 Columns

#### 2. Insights from EDA Process

##### (1) The Number of Confirmed Cases and Deaths

In the process of EDA, we found an interesting fact that the correlation between the number of deaths and the number of confirmed cases was not very high, and we thought this was due to the spread of delta mutations that did not have a high fatality rate. Since then, we also thought that the decrease in critical patients as immunity has been strengthened due to the

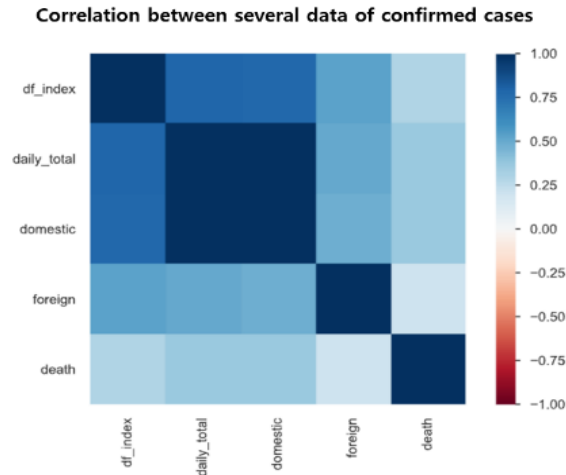


Fig 3. Low Correlation Between the Two Numbers

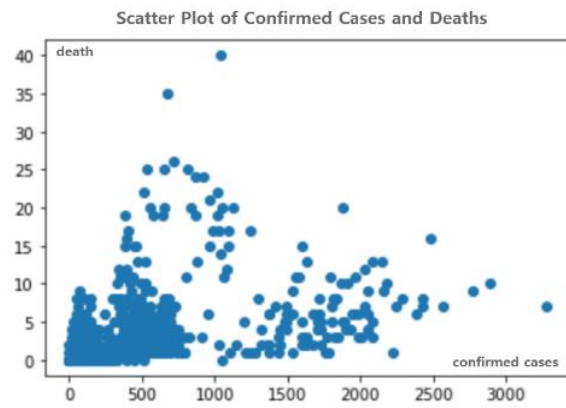


Fig 4. Scatter Plot of the Two Numbers

increase in vaccination rates has affected to some extent. This discovery gave us some ideas to define one of the most important conditions we need to enter the with-COVID era as showing a low death rate, even if the number of confirmed cases is quite high.

## (2) Confirm Rate Indicator We Newly Produced

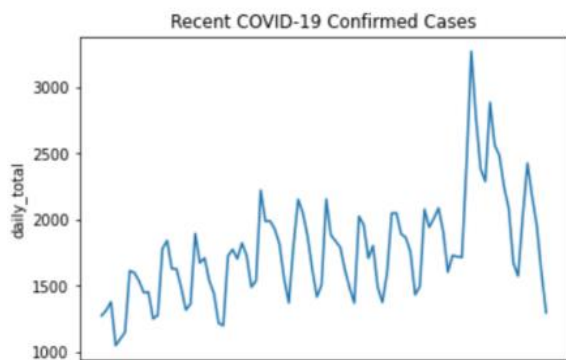


Fig 5. Recent (Sep~Oct) Confirmed Cases

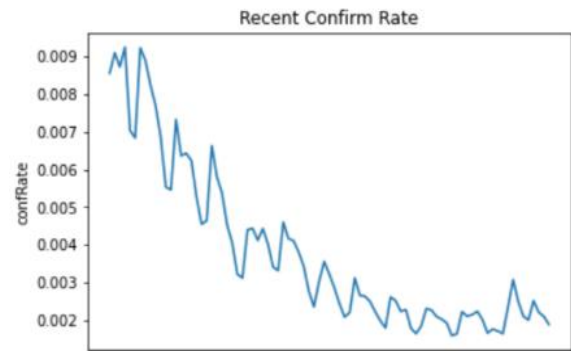


Fig 6. Recent (Sep~Oct) Confirm Rate

We thought it was difficult to explain the spread with only the number of confirmed cases, so we tried to produce a confirm rate by dividing the number of confirmed cases by the total number of inspections (corona test). As a result of referring to data through the confirm rate from September to October, which recorded the highest number of confirmed cases, it was found that the number of confirmed cases continues to increase, but the confirm rate itself is decreasing.

Of course, the government may or may not have been using flawed data to make policy decisions. Anyone can't know whether it is true or not because data may or may not reflect the reality well. We tried to continue thinking about how to develop several indicators that best explain the spread of COVID-19, but we thought we were not yet intellectually rich enough to produce any statistical indicators and failed to find answers due to difficulties in collecting additional data related to COVID-19.

However, we realized that simply analyzing the spread only with the number of confirmed cases may not be a desirable approach. We thought various approaches are needed, which has helped us analyze the quarantine model countries with new indicator which is produced by us from a long-term perspective.

## (3) The Number of Confirmed Cases and Vaccinations



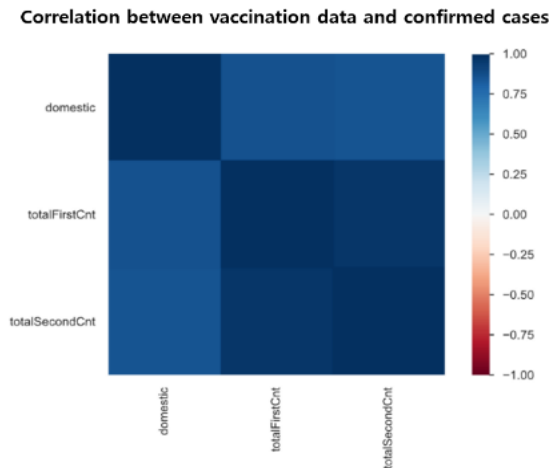


Fig 7. High Correlation Between Vaccination Rate and Confirmed Cases

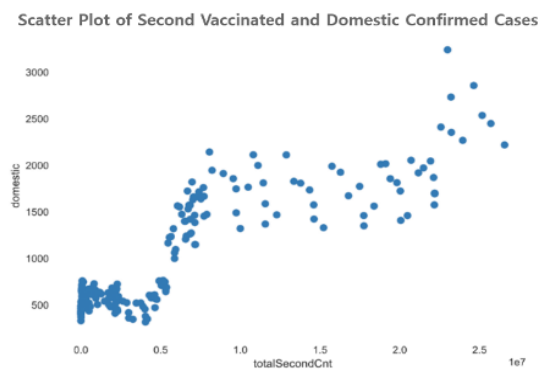


Fig 8. Scatter Plot of the Second (Fully) Vaccinated Cases and Confirmed Cases

The correlation between the vaccination rate and the number of confirmed cases showed that the spread did not decrease despite the increase in the vaccination rate. This served as a basis for our argument that Korea should introduce additional policies other than vaccination policies and distancing policies.

#### (4) The Number of Movements and Social Distancing Level

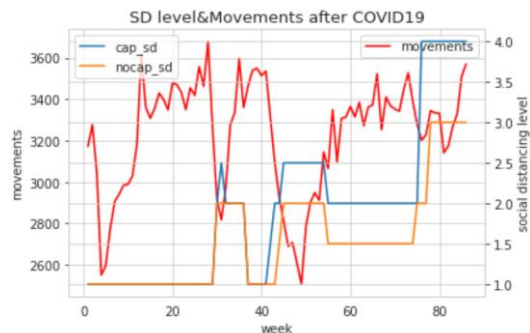


Fig 9. Movements of People and Social Distancing Level

In the case of Korea, the ‘social distancing’ policy was implemented in consideration of its strong propagation power in the early stages of COVID-19. In fact, people's movement decreased when the social distancing level increased, and movement increased when the social distancing level was lowered.

However, the amount of population movement has no longer shrunk as the high distance stage(level 4) continues since July 2021. The delta mutation, which appeared around July 2021, was much stronger in propagation, making it difficult to prevent it simply by avoiding contact, and experts raised the need for herd immunity. As the number of confirmed cases continued to increase from about July, the distance policy was strengthened, and as it continued until the end of October, the amount of movement increased again, and the distance policy became virtually meaningless. When the social distancing level is strengthened, there is no significant effect on the amount of movement, this means that policy should be changed necessarily.

## IV. Data & Policy Analysis

### 1. The Analysis of the Quarantine Model Countries

#### (1) The Importance and Necessity of Early Quarantine Learned from Taiwan

Taiwan has maintained a stable spread situation by establishing a very rapid regional lockdown, quarantine, and test system for confirmed patients since the outbreak, recording zero confirmed cases in about 8 months last year. Especially, we should note that punishment for violators of quarantine rules was immediately taken, and that they intervened in the process of supplying masks and quarantine supplies in advance and prepared countermeasures [7]. The policies they showed are nothing special. Rapid measures and policy implementations in preparation for future worse situations led to the success of initial quarantine.

Starting with the confirmation of an airline pilot in April, the number of confirmed cases increased slightly in May, but they also showed an appropriate response and regained stability from June. Since mid-

Compared to Korea, the intensity of quarantine measures was relatively strong, but the biggest difference between Korea and Taiwan lies in citizen participation. In the case of Korea, the current government has been criticized a lot since last year as the people have continuously demanded that welfare policies support the lives of small business owners. However, in Taiwan, quarantine was more important than economy, and through this, all citizens actively participated in quarantine measures to achieve the ultimate goal of returning the economy to its original position [8]. This shows how importantly the overcoming of the COVID-19 situation is politically related. The credibility and support gained from the public lead to the establishment and progress of certain policies and to effective quarantine.

## (2) The Importance and Necessity of Systematic Online Education Learned from New Zealand

New Zealand COVID-19 Alert Levels Summary			
<p>The Alert Levels are determined by the Government and are the public's high and low level of measures to be taken to help prevent COVID-19. Further guidance on what to do is in the <a href="#">COVID-19 Alert Levels</a> page.</p> <p>Alert Level 1 is the lowest level of measures to be taken. Alert Level 4 is the highest level of measures to be taken.</p> <p>The Alert Levels are determined by the Government and are the public's high and low level of measures to be taken to help prevent COVID-19. Further guidance on what to do is in the <a href="#">COVID-19 Alert Levels</a> page.</p>			
<p><b>ELIMINATION STRATEGY</b> - New Zealand is working together to eliminate COVID-19</p>			
Alert Level	Risk Assessment	Range of Measures (some additional to mandatory)	Business Operations
<b>Level 4 – Lockdown</b>	<ul style="list-style-type: none"> <li>Contaminated surfaces</li> <li>Highly contagious virus</li> <li>Highly contagious virus</li> <li>Highly contagious virus</li> </ul>	<ul style="list-style-type: none"> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> </ul>	<ul style="list-style-type: none"> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> </ul>
<b>Level 3 – Restrict</b>	<ul style="list-style-type: none"> <li>Contaminated surfaces</li> <li>Highly contagious virus</li> <li>Highly contagious virus</li> <li>Highly contagious virus</li> </ul>	<ul style="list-style-type: none"> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> </ul>	<ul style="list-style-type: none"> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> </ul>
<b>Level 2 – Reduce</b>	<ul style="list-style-type: none"> <li>Contaminated surfaces</li> <li>Highly contagious virus</li> <li>Highly contagious virus</li> <li>Highly contagious virus</li> </ul>	<ul style="list-style-type: none"> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> </ul>	<ul style="list-style-type: none"> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> </ul>
<b>Level 1 – Prepare</b>	<ul style="list-style-type: none"> <li>Contaminated surfaces</li> <li>Highly contagious virus</li> <li>Highly contagious virus</li> <li>Highly contagious virus</li> </ul>	<ul style="list-style-type: none"> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> <li>Everyone must stay at home</li> </ul>	<ul style="list-style-type: none"> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> <li>Business operations are restricted to essential services</li> </ul>

New Zealand has developed its own infectious disease prevention warning stage system to show a planned and careful quarantine policy. After declaring the highest level 4-lockdown of the alert level in March, the alert level was eased to level 3-restrict at the end of April, level 2-reduce in mid-May, and level 1-prepare in June [10].



The educational policy they showed contrasts very much with Korea's conflicting educational policy. Ahead of the 2020 CSAT, Korea was in a hurry to postpone the schedule of students' school days and CSAT exams without being able to be fixed. The Ministry of Education's temporary policies were sufficient to cause confusion between students and their parents, and when the school began to resume, they were more criticized negatively by parents and students.

Australia has a relatively weak medical system. However, in terms of the welfare system, it shows a very high level. Australia's high-quality welfare, such as guaranteeing fewer working hours for workers, conflicts with a weak medical system, making it



unlikely that beds will be operated at the maximum. They knew exactly this problem, so they also implemented a strong lockdown policy.

Australia solved the problem by operating a high-quality welfare system immediately for economic damage, such as setting compensation in proportion to sales before COVID-19 and paying it to small business owners. This contrasts with South Korea's recent hesitation in paying national disaster support funds and failing to implement it. Australia continues to show welfare policies that compensate self-employed people for the damage caused by such strong lockdown measures, even though their ruling party is a conservative party [11].

However, there were cases in Australia where a small number of people ignored the quarantine rules, opposed vaccination, and protested without masks. In the wake of the incident, the effect of strong lockdown measures collapsed at once, and the media criticizes it is due to a weak punishment for those who violate quarantine rules. This reminds us that Taiwan succeeded in initial quarantine with strong punishment, and it leads to a lesson that strong punishment should be also imposed on Korean violators of quarantine rules because Korea is also weaker than other countries. We should not recreate the Shincheonji nightmare again.

#### (4) Recent 30 Days Increase Rate of Confirmed Cases Compared to Previous 30 Days of Three Countries

As mentioned in the previous contents, the reason why they are called quarantine model countries is that they showed very good responses in the early stages before the spread of COVID-19 began in earnest. In order to understand how their response affected the spread of COVID-19 from a long-term perspective, we produced an indicator: recent 30 days increase rate of confirmed cases compared to previous 30 days. We analyzed the spread on a kind of one-month basis. This rate was calculated by dividing the total number of confirmed cases of recent 30 days from the current by the total number of confirmed cases from 60 days ago to 31 days ago. The x value is an index value that occurs when the periods are sorted in order within the excel (Date values made confusion on the graphs, so we used the index instead of it).

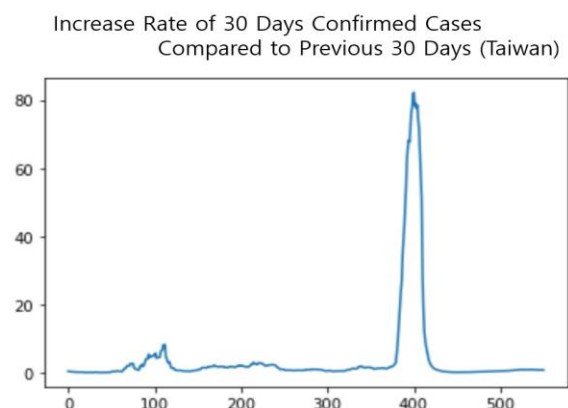


Fig 12. The Increase Rate of Taiwan

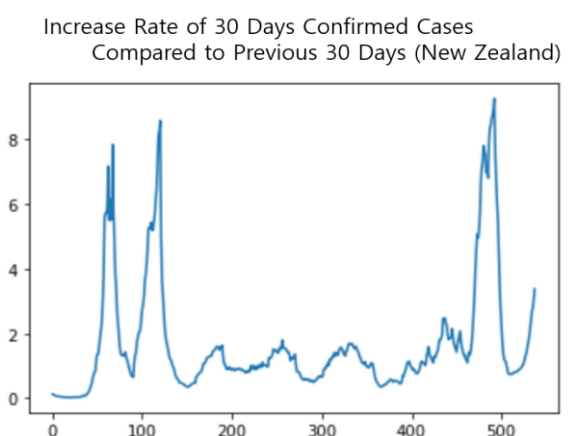


Fig 13. The Increase Rate of New Zealand

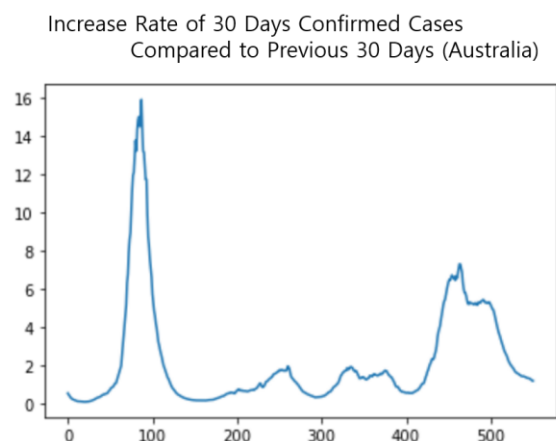


Fig 14. The Increase Rate of Australia

They generally have a relatively high value only near index 100 and index 400 to 500. It shows that the countries responded very well because they have maintained close to zero increase rates, or just small fluctuations in values within double increase rates. That is, although there are some increasing points (like double rate), decreasing points, which is under the rate value 1, occur immediately and repeatedly.

Taiwan			New Zealand			Australia		
90	27/06/2020	0	10/07/2020	1		27/06/2020	85	
91	28/06/2020	0	11/07/2020	1		28/06/2020	78	
92	29/06/2020	0	12/07/2020	0		29/06/2020	70	
93	30/06/2020	0	13/07/2020	1		30/06/2020	86	
94	01/07/2020	0	14/07/2020	2		01/07/2020	81	
95	02/07/2020	1	15/07/2020	1		02/07/2020	65	
96	03/07/2020	1	16/07/2020	1		03/07/2020	194	
97	04/07/2020	0	17/07/2020	1		04/07/2020	183	
98	05/07/2020	0	18/07/2020	3		05/07/2020	140	
99	06/07/2020	0	19/07/2020	1		06/07/2020	172	
100	07/07/2020	0	20/07/2020	1		07/07/2020	131	
101	08/07/2020	0	21/07/2020	0		08/07/2020	170	
102	09/07/2020	0	22/07/2020	0		09/07/2020	318	
103	10/07/2020	0	23/07/2020	1		10/07/2020	179	
104	11/07/2020	2	24/07/2020	0		11/07/2020	244	
105	12/07/2020	0	25/07/2020	0		12/07/2020	183	
106	13/07/2020	0	26/07/2020	0		13/07/2020	271	
107	14/07/2020	0	27/07/2020	1		14/07/2020	236	
108	15/07/2020	0	28/07/2020	2		15/07/2020	323	
109	16/07/2020	0	29/07/2020	1		16/07/2020	423	
110	17/07/2020	0	30/07/2020	0		17/07/2020	208	

Fig 15. Actual Date and Number of Confirmed Cases Near Index 100

The period near index 100 is around July 2020, with the number of confirmed cases recording single digits or rarely reaching double digits. So it's not meaningful. All three countries have a relatively high growth rate in the second half (around the x value of 400 to 500). In the case of Taiwan, it shows an increase rate of almost 80 near index 400. In the case of New Zealand, it shows an increase rate of almost 10 near the late 400th index. Finally, Australia also shows an increase rate of almost 8 near the mid-400 range. If you look up this period accurately, these are the periods shown in the figure 17 below.

Taiwan			New Zealand			Australia		
400	03/05/2021	8	490	14/08/2021	5	460	02/07/2021	50
401	04/05/2021	8	491	15/08/2021	7	461	03/07/2021	19
402	05/05/2021	7	492	16/08/2021	0	462	04/07/2021	51
403	06/05/2021	13	493	17/08/2021	10	463	05/07/2021	27
404	07/05/2021	5	494	18/08/2021	0	464	06/07/2021	30
405	08/05/2021	5	495	19/08/2021	32	465	07/07/2021	42
406	09/05/2021	1	496	20/08/2021	24	466	08/07/2021	48
407	10/05/2021	15	497	21/08/2021	24	467	09/07/2021	64
408	11/05/2021	11	498	22/08/2021	38	468	10/07/2021	85
409	12/05/2021	21	499	23/08/2021	42	469	11/07/2021	121
410	13/05/2021	25	500	24/08/2021	63	470	12/07/2021	102
411	14/05/2021	34	501	25/08/2021	68	471	13/07/2021	106
412	15/05/2021	185	502	26/08/2021	70	472	14/07/2021	84
413	16/05/2021	207	503	27/08/2021	83	473	15/07/2021	113
414	17/05/2021	335	504	28/08/2021	84	474	16/07/2021	145
415	18/05/2021	243	505	29/08/2021	55	475	17/07/2021	128
416	19/05/2021	273	506	30/08/2021	50	476	18/07/2021	117
417	20/05/2021	292	507	31/08/2021	50	477	19/07/2021	104
418	21/05/2021	314	508	01/09/2021	76	478	20/07/2021	146
419	22/05/2021	723	509	02/09/2021	84	479	21/07/2021	160
420	23/05/2021	460	510	03/09/2021	19	480	22/07/2021	156
421	24/05/2021	595	511	04/09/2021	20	481	23/07/2021	171
422	25/05/2021	539	512	05/09/2021	24	482	24/07/2021	165
423	26/05/2021	635	513	06/09/2021	21	483	25/07/2021	164
424	27/05/2021	670	514	07/09/2021	16	484	26/07/2021	184
425	28/05/2021	554	515	08/09/2021	18	485	27/07/2021	207
426	29/05/2021	491	516	09/09/2021	19	486	28/07/2021	253
427	30/05/2021	354	517	10/09/2021	24	487	29/07/2021	183
428	31/05/2021	351	518	11/09/2021	23	488	30/07/2021	221
429	01/06/2021	331	519	12/09/2021	36	489	31/07/2021	253
430	02/06/2021	547	520	13/09/2021	17	490	01/08/2021	229

Fig 16. Actual Date and Number of Confirmed Cases Near Index 400~500

The index around 400 to 500 is as follows if you look at the exact period for each country. This period was a time when it was difficult to reduce the spread immediately due to the epidemic of delta mutations internationally. Although they are called quarantine model countries but failed to reduce their spread in this period.

## 2. Analysis of the Implementing with-COVID Countries

### (1) With-COVID Policies

With-Covid policy refers to a step-by-step recovery of daily life and is a newly raised policy as the effectiveness and sustainability of quarantine measures have decreased due to accumulated damage to self-employed and small business owners. The direction of policy implementation is as follows.

1) For phased and gradual recovery, new transition standards such as vaccination completion rate, intensive care unit and hospital bed capacity, weekly severe patients and deaths, and epidemic scale will be set, and quarantine measures will be eased in the order of living facilities, large-scale events, and private gatherings.

2) in order to inclusive recovery, we focus on narrowing the economic and social gap and restoring people's livelihoods so that no class can be alienated and all citizens can enjoy their daily lives.

3) Finally, opinions will be actively collected around the Daily Recovery Support Committee to minimize the temperature difference between the government's plan for daily recovery and the people's expectations for recovery with the people.

Through this, the government intends to pursue another form of life that coexists with COVID-19 while restoring daily life step by step, even if it cannot return to the pre-COVID-19 era [12].

Several governments recommended vaccination and implemented the "With-COVID" policy one by one, starting when the vaccination rate exceeded a certain level. With COVID-19 policy is also called a step-by-step daily recovery and refers to a new quarantine system that focuses on the management of severely ill patients while partially easing social distancing. There are two implementation conditions of the With-

COVID policy. First, the fatality rate of COVID-19 should be lower than the fatality rate of the flu of 0.1% [13]. In other words, by increasing the vaccination rate, the fatality rate is reduced, and the number of severely ill patients is reduced. Second, it should be possible to protect unvaccinated people, induce infected people within a controllable range through tests, tracking, and isolation, and secure antiviral drugs. Prevention of COVID-19 is also important, but treatment and recovery are also important.

## (2) The Number of Confirmed Cases

For our visualization, we used a mix of Python and RStudio. We started by analyzing the evolution of the total number of cases each day, to see the consequences of the with-covid life on the contaminations. Without too many surprises, we saw that the number of cases exploded after the switch in the three test countries. These three graphs show the evolutions, with the black representing the date when the with-corona life started.

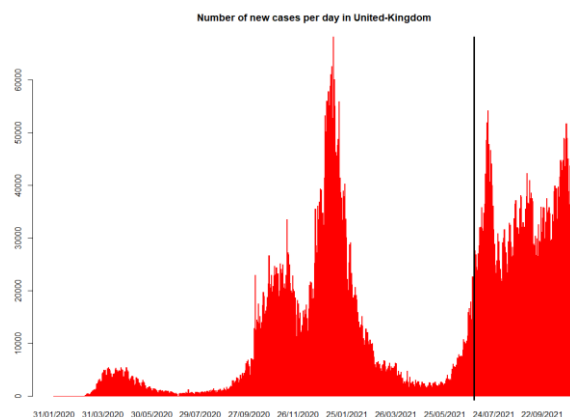


Fig 17. Number of Daily New Cases in the UK

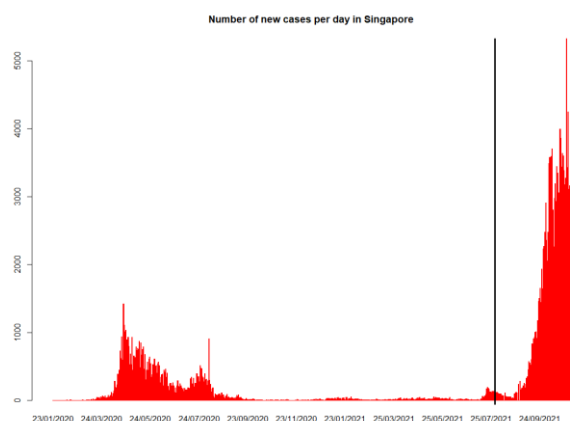


Fig 18. Number of Daily New Cases in Singapore

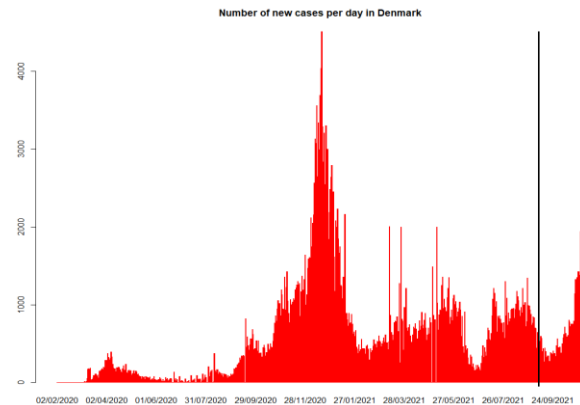


Fig 19. Number of Daily New Cases in Denmark

But we can't stop our analysis here. Indeed, even if the number of cases is rising, this is a logical consequence of abolishing all the social distancing and rules that were precisely trying to reduce the number of contaminations. What we want to prove is that those new cases aren't serious cases, i.e., that they are not inducing severe hospitalizations or deaths.

## (3) Death Rate

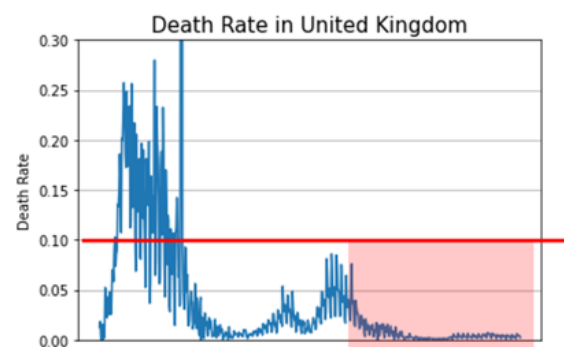


Fig 20. Death Rate in the UK After the Outbreak

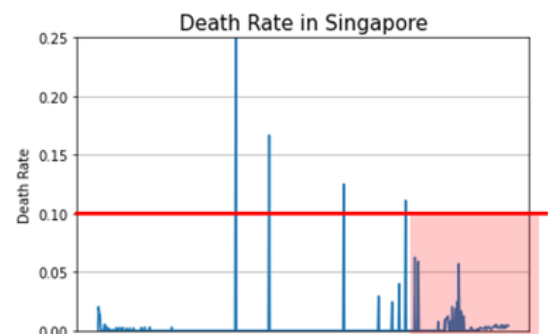


Fig 21. Death Rate in Singapore After the Outbreak

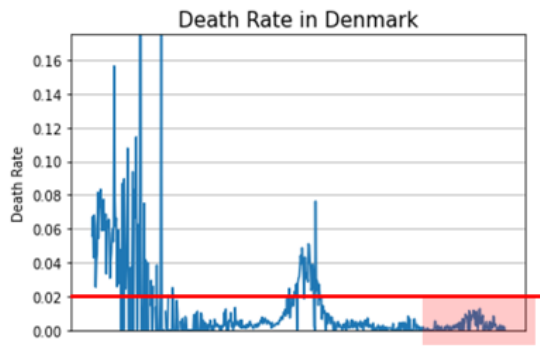


Fig 22. Death Rate in Denmark After the Outbreak

In the case of the UK, the fatality rate has been lower than 0.1% since July when With-COVID policy began. Singapore has also maintained a mortality rate of less than 0.1% since August when With-COVID began, and Denmark has maintained a mortality rate of less than 0.02%.

#### (4) Vaccination Rate

Country	1 <sup>st</sup> dose	2 <sup>nd</sup> dose
United Kingdom	67%	50%
Singapore	73%	58%
Denmark	76%	72%

Table 2. Vaccination Rate for the Three Countries

Looking at the vaccination rate at the time of implementation of the policy, the UK had 67% for the first dose of vaccine, 50% for the second dose. Singapore had 73% for the first, 58% for the second. And Denmark had 76% and 72% for each. Considering that there was a debate over whether the timing of the second vaccination was 50% or 70%, it can be said that the UK and Singapore implemented the With-COVID policy starting with the second vaccination rate of 50% and Denmark with the second vaccination rate of 70%.

#### (5) ICU Patients Rate

We emphasized our study on the situation of the hospitals. The best way to show that the daily new cases are not serious cases is to look at the proportion of contaminations that leads to a hospitalization or a severe hospitalization, and that's exactly what we did.

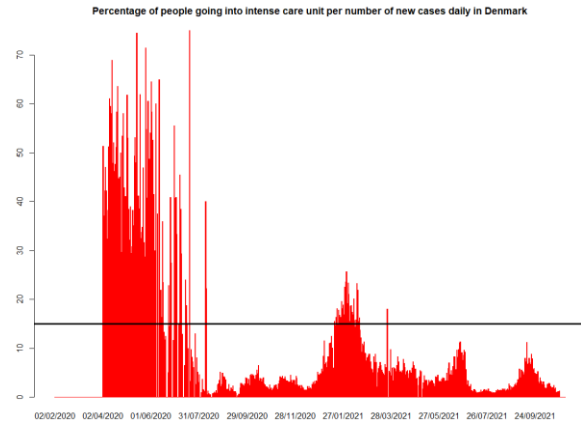


Fig 23. ICU Patients Rate in Denmark

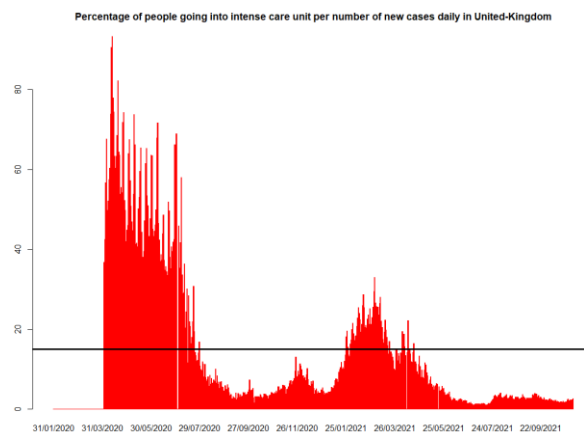


Fig 24. ICU Patients Rate in the UK

On these graphs, we can see the percentage of daily admission of patients in ICU per new cases in the hospitals of Denmark and the United-Kingdom. The ICU is the intense care unit of a hospital, and it represents the most severe cases that require a very strong medical assistance. We will use this number as an indicator of the severity of the cases at a given time. What we can see on these graphs is that at the start of the epidemic, this rate was really high, because it was at this moment that the Covid was the most harmful. But after the implementation of with-corona, we can also see that even if the number of cases is rising, the proportion of people getting into ICU is maintaining, which means that the pandemic isn't as dangerous as before. We added the horizontal black line, which represents the rate of the Flu, which is another contagious disease already accepted in our everyday life. By comparing with the Flu, we can see that the rate of covid is inferior to Flu's [17, 18].

## (6) Hospital Urgency

In addition to the ICU patient rate, we wanted to observe the urgency of the situation in the hospitals, to see if the countries were close or not from having a saturation of their medical system. To do so, we initially wanted to look at the evolution of the daily percentage of bed occupancy in the hospitals. Indeed, if we see that this percentage is high, that means that the hospitals are threatened to be saturated, and that some people requiring a medical assistance wouldn't get any places, which is an important problem. Unfortunately, due to the fact that we're dealing with medical data, we couldn't get every information we needed to make such a graph, and we needed to find another index. With some feature engineering and with the data we already had, we managed to create a brand-new indicator of this hospital saturation: by dividing the total number of bed in a country by the daily number of hospital admissions, we get the number of day before the hospitals get saturated and have an index about how critique is the situation.

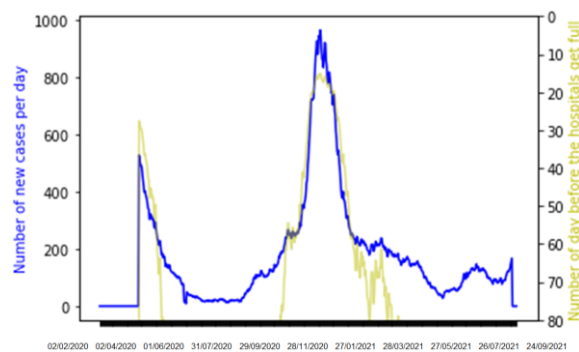


Fig 25. Hospital Urgency in Denmark

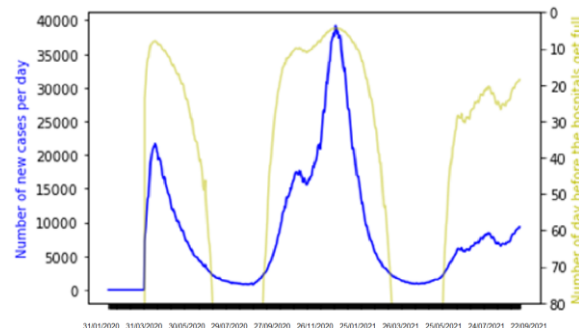


Fig 26. Hospital Urgency in the UK

On these graphs, we can see two lines. The blue one represents the evolution of the daily number of admissions over time, and the second one represents

our indicator. To get a clearer idea of what means this indicator, let's take an example. If we place ourselves at the first spike in Denmark, the blue line tells us that there are nearly 1000 new admissions each day, while the yellow line shows that at this rhythm, it will take less than 20 days to totally fill the hospital places. Indeed, there are about 14 533 hospital beds in Denmark, so 1000 admissions per day mean 14 days before the hospitals get saturated.

If we now focus on after the implementation of with-covid life, we can see that for Denmark, the number of admissions remains kind of low, while the hospitals are not threatened of saturation at all. But it is not the case for the United-Kingdom, which demonstrates a new spike after the switch.

## (7) Analysis of Korea Based on the Three Countries



Fig 27. Death Rate in Korea After the Outbreak

Country	1 <sup>st</sup> dose	2 <sup>nd</sup> dose
Korea	80%	75%

Table 3. Vaccination Rate for Korea

We looked at the case of Korea based on the above precedents. First of all, the death rate of COVID-19 remained below 0.1 percent after the start of With-Covid in all three countries. As mentioned earlier, this can be compared to the death rate of the flu. Currently, the flu is not introduced as an isolation or distancing system, but is vaccinated against influenza and treated through medication. If the death rate continues to remain below 0.1%, Covid can also be prevented and treated in the same form as the flu. Looking at the its death rate on October 31, just before the start of Korea's With-Covid policy, it is less than 0.1%, and it can be seen that Korea is also starting the With-Covid policy in a stable state in terms of the death rate.



Second, in the case of Denmark, where the death rate is significantly lower among the three countries, when we analyzed the Hospital Urgency, the bed was stably operated, so it can be said that the With-Covid policy was successfully introduced in Denmark. In order for Korea to stably implement With-Covid, it is possible to refer to Denmark's good precedent. When comparing vaccination rates in the three countries, Denmark started with a secondary vaccination rate more than 70%, which we can infer that the fully-vaccination rate and the death rate will be related. In other words, it is possible to lower the degree of health risks from Covid by activating the immune system through fully-vaccination. As of October 31, Korea's half-vaccinated rate was 80% and the fully-vaccinated rate was 75%, exceeding 70%. These figures suggest that Korea can stably implement the With-Covid policy in terms of vaccination rates.

Finally, even if at first sight the switch to the life with Covid-19 seems like a risky idea, because it drastically increases the number of new cases, we saw that if we meet certain conditions, those cases are not serious ones, and a life without social distancing rules can be envisaged. Indeed, we saw with the examples of Denmark and the United-Kingdom the number of people joining the ICU each days was maintaining at a low level, and that for Denmark, the hospitals are safe. However, in the United-Kingdom, the hospital could face some problem if the number of admissions keep rising. This difference could be explained by the fact that at the moment those two countries switched to life with covid, Denmark had a really high vaccination rate, with 72% of people having their 2 doses, while United-Kingdom had only 50%. The vaccination appears like a crucial condition to the life with-corona policy.

## **V. Proposal Solution**

### **1. Lessons from the Analysis of the Quarantine Model Countries**

We were able to obtain the following conclusions through the analysis of the increase rate of 30 days

confirmed cases compared to previous 30 days. Existing vaccines have some side effects and may be difficult to show full effect on the coronavirus mutant species. Although it was not included in the data during the study period, it is difficult to properly expect the vaccine effect on the recent Omicron mutant species. In addition, the emergence of mutations is generally more contagious, even if the fatality rate may be lower in the absence of a perfect treatment. Therefore, the increase in the number of confirmed cases after the appearance of mutations is inevitable. Those who are called exemplary quarantine countries can also say that the quarantine system, which was close to perfect, has been somewhat shaken since the emergence of the delta mutant species. This suggests that in the post-Corona era, we need to come up with prior policies to cope with mutations. When a mutation begins to occur, policies related to movement restrictions at home and abroad should be implemented immediately and a PCR test system that can distinguish mutant species should be prepared in detail. In addition, laws and obligations related to movement tracking should be clarified so that the movement of the first infected mutant in Korea can be clearly identified. In the case of Korea, it was very insufficient to grasp the movement of the first confirmed patient of COVID-19 and the confirmed patient who was the main spreader of the Shincheonji-centered spread. And there was also a setback in identifying the movement of the first spreader of the current Omikron mutation. Through these experiences, Korea realized that it lacked significantly the ability to cope with mutations. For these reasons, the policies mentioned above are essential as policies for the post-Corona era.

### **2. Lessons from the Analysis of the Implementing With-COVID Countries**

If we are respecting all those measures well enough, the disease become benign for the population and a switch back to a normal life without social distancing rules is possible. But we saw with the study on Denmark, Singapore and the United-Kingdom that this switch shouldn't be rushed. Indeed, a lot of countries in the world have experienced a rapid recovery of the number of cases once they decreed the life with corona, and this augmentation can lead to a

resurgence of the severe cases, and inevitably deaths if we're not meeting certain conditions. The good example was what did Denmark, waiting for a really low number of cases per day, and a high vaccination among the population. United-Kingdom had 50% of fully vaccinated people when they switched to life with-corona, and it led to a threat of their hospitals during the next week. We would recommend waiting for a higher vaccination rate, like 70% minimum which was the number of Denmark.

## **VI. Conclusion**

### **1. Summary**

We looked into whether Korea has policies that can be referenced or benchmarked from quarantine model countries to prepare for the post-Corona era. In addition, we thought about whether the current situation in Korea is appropriate for implementing the with-COVID policies or what conditions are for implementing it.

Taiwan has shown how important early quarantine against infectious diseases is economically. The high civic participation rate and government approval rate accompanied by them suggest that we also need political efforts to cope with infectious diseases in the future. In addition, New Zealand's educational policies showed a very clear and systematic appearance, which contrasts very much with Korea's educational policies, which have caused confusion every time. Australia implemented a lockdown policy that was most suitable for them based on accurate judgment of their country. In addition, Korea and Australia were able to form a consensus that punishment for violators of quarantine rules needs to be strengthened. The growth rate of the number of confirmed cases on the 30 days, analyzed from a long-term perspective, suggests that we should set up measures for mutations in the future, such as advanced PCR tests and tracking of confirmed patients' movements.

South Korea started with-COVID with high vaccination rate that was completely similar with the countries that first implemented it. In addition, the

death rate and ICU patient rate also decreased to flu levels. Of course, they should be criticized for securing vaccine supplies, but it can be said that starting with-COVID was conditionally quite stable. However, the most important thing is to secure beds for severely ill patients (ICU patients). This will be something that Korea should pay a lot of attention to in the future.

### **2. Significance & Limitations**

Our study is meaningful in that it shows an approach from a data science perspective beyond the methods of general policy analysis and policy proposal. The policy research studies we found through Bibliography were generally based on the researcher's arguments and logic, and it is difficult to say all of them use scientific methods. Although various statistical data were used, there was no way to check whether the data they used was accurate or biased because they were not directly collecting or processing. In addition, we have been able to see many studies in a way that suggests introducing policies into Korea mainly based on overseas policies.

We propose to introduce overseas policies into Korea based on the research method of previous studies collected through Bibliography, but we tried to set standards for selecting good policies through data science. An example is to discover the time when the spread was reduced through data scientific methods and to extract outstanding policies that were carried out during that time. In addition, in the stage of analyzing the countries implementing with-COVID, an insight was derived that the death rate showed insignificant changes even though the number of confirmed cases simply increased.

In conclusion, we comprehensively analyzed the global situation and policies of COVID-19 through data science, and we were able to propose policies that can prepare for the post-COVID era in the future. Since we are not professional researchers, we will not be able to show high levels of research and high application and utilization, but we will be able to develop the power to tell stories we want to tell and persuade people around us through data science.

### 3. Follow-up Research & Expected Use

Moreover, our research also has the significance of predicting the results of Korea based on data before November (Korea implemented the With-corona system in earnest from November). Therefore, not only this study, but also follow-up studies can be conducted after the end of this study, and we will be able to check whether our predictions are correct by referring to additional data for one to two months (November ~ December). I think the success of prediction that we will get through the follow-up study will provide many lessons and implications for us who are undergraduate students majoring in data science to refer to for more profound data science study in the future.

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