Thesis

Our proposed solution is to tighten social distancing measures as a preventive measure to ensure that our healthcare system is not overwhelmed. Our predictive algorithm would consider the capacity of our Intensive Care Unit (ICU) wards that have been reserved for Covid patients and predict the allowed group sizes that we would need to restrict social gatherings, to maintain the healthcare system.

Data collected:

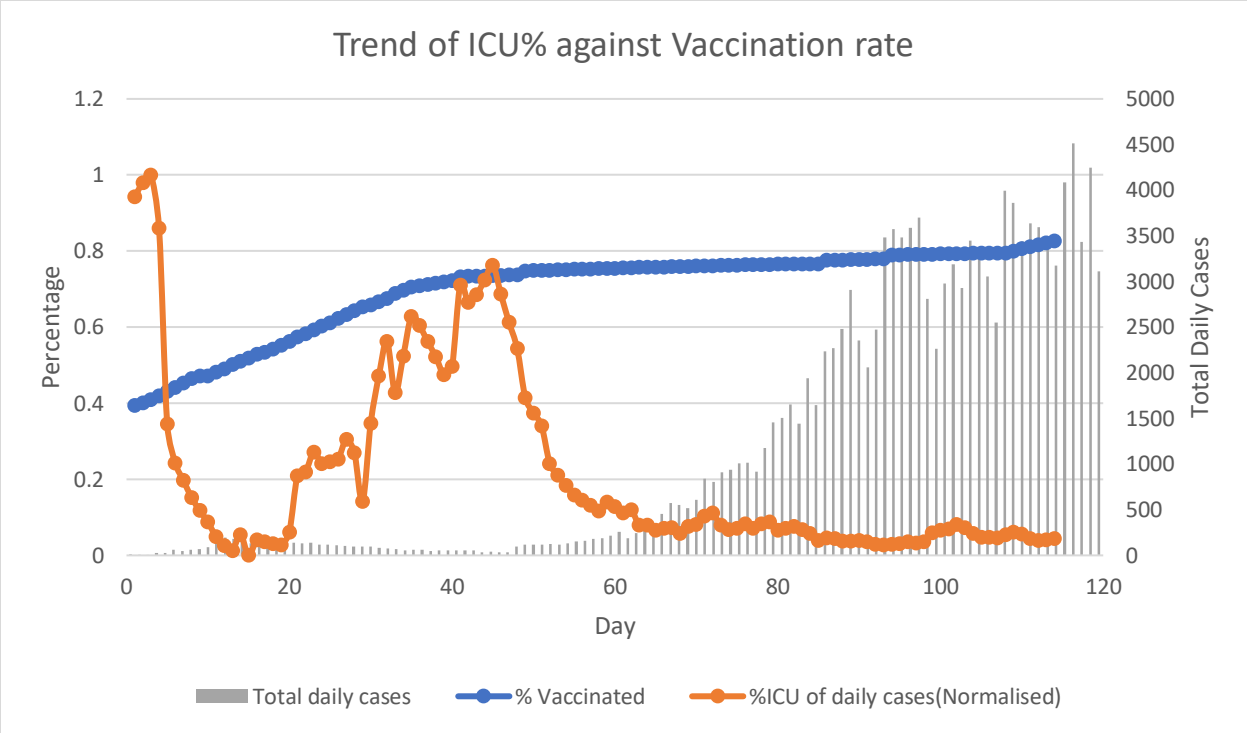
1. Total daily cases from 01/07/2021-31/10/2021 (Ministry of Health)
2. Number of patients in ICU (Ministry of Health)
3. Vaccination rates (covidvax.live)
4. Average duration of stay in ICU (Teo, 2021)

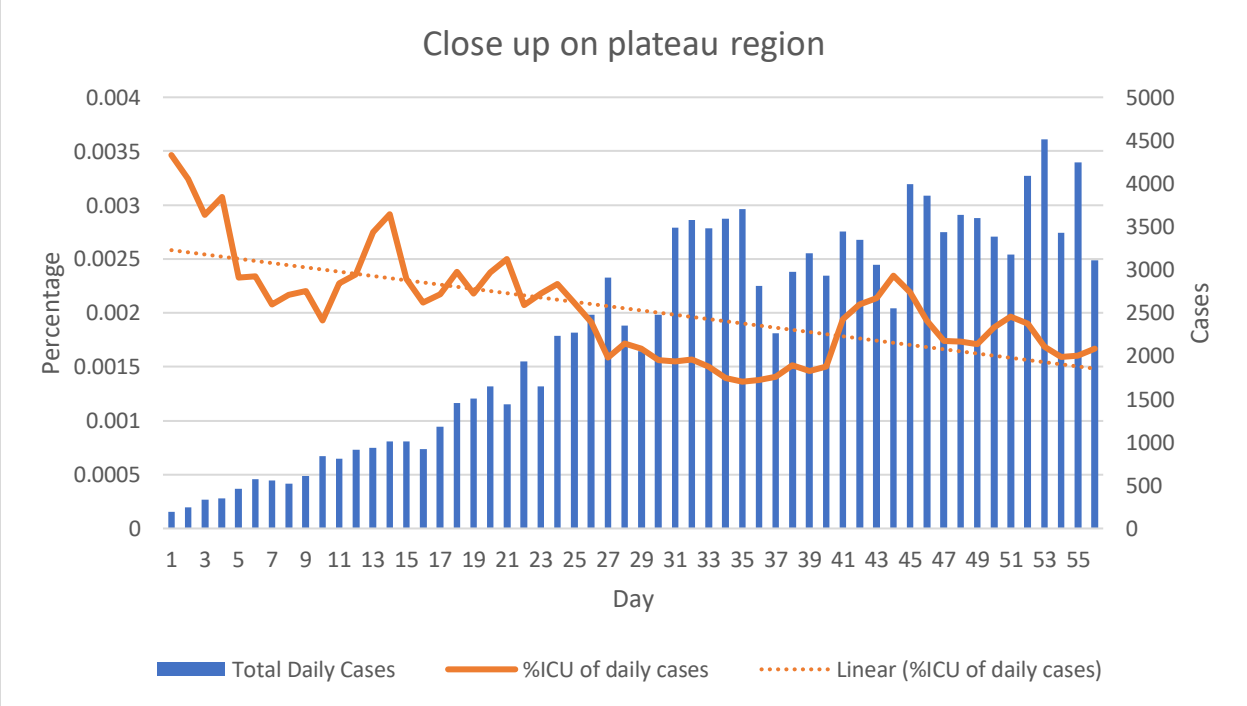
Assumptions:

1. 219 ICU beds reserved for Covid-19 patients (Goh, 2021)
2. All vaccines have equal efficiency
3. Daily Percentage of Covid-19 patients with serious symptoms is relatively constant after plateau
4. Average stay of patients in ICU is 15 days
5. The factors considered in the regression equation are the main factors affecting the predicted number of cases in 14 days

Maximum allowed cases

Since the average stay of patients in the ICU is 15 days, we took currently infected patients to be a sum of the past 15 days of reported daily cases. We modelled the rate of serious cases as a percentage of currently infected cases. The vaccination rate and number of daily cases are also shown for context. Percentage of ICU cases has been normalized to highlight the trend more clearly.





As can be seen from the graphs, the rate of serious cases has plateaued, around Day 60 which corresponds to 7 September 2021 and this allows us to get a good prediction on the % of daily cases that will end up in the ICU beyond 31st October 2021. We calculated the average %ICU of daily cases within the period of 7 September to 31

October. We then took the number of beds in ICU reserved for Covid-19 patients and divided it by the average %ICU of daily cases to obtain the number of cases that will result in full utilization of the 219 beds. Then taking that number of cases, we further divide it by 15 which corresponds to the average LOS of a covid-19 patient in the ICU, which will then give us the average maximum number of allowed daily cases, otherwise, ICU capacity will be exceeded. This maximum number of allowed daily cases, amounted to 7184.

Multiple Linear Regression Model

We created a multiple linear regression model to predict the number of cases that Singapore will see in 14 days with the variables being the daily reported cases, vaccination rate, and the allowed group size for social gatherings.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.93285596
R Square	0.87022025
Adjusted R Square	0.86579594
Standard Error	482.050263
Observations	92

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	137116448.8	45705482.9	196.690622	6.75294E-39
Residual	88	20448776.13	232372.456		
Total	91	157565224.9			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-1364.59379	333.2008576	-4.095409	9.3373E-05	-2026.76048	-702.4271
Vax Rate(X1)	1334.99878	609.5196114	2.19024746	0.03115053	123.7066367	2546.29093
Total Daily Case(X2)	1.2296649	0.072555426	16.9479387	1.8752E-29	1.085476242	1.37385357
Grp Size(X3)	203.995351	44.67519426	4.56618833	1.6057E-05	115.2127899	292.777911

Using the weights and constants obtained after training the regression model, we can then substitute in the current Daily Case and Vaccination Rate alongside the maximum number of allowed daily cases calculated previously to obtain the maximum group size that could be allowed. The result of our model can then be part of the consideration when deciding on whether to relax or stricken safe distancing measures.

Evaluation

However, our multilinear regression model has a few limitations that affected the accuracy of the model.

Firstly, we chose to train our model with only data from July to October as these few months more accurately represented the current climate of covid in Singapore as compared to data from last year or even at the start of the year. Hence, to further improve the accuracy of our model, we could use future data when the country open up to train the model again to keep the model updated and robust.

Secondly, we could include more factors into our regression equation such as percentage of working population is working from home or the general health of Singaporeans. However, some of these data are not readily available or not easily quantifiable.

Another limitation is that this model is used to predict a limit as to how:

1. Limited Dataset as we chose data that more closely represented the current climate of COVID in Singapore

2. Limited availability(Hard to quantify) of other variables that could be possible contributing factors to the number of cases(spread of covid)

Sources:

Ministry of Health. Retrieved 10 November, 2021, from *https://www.moh.gov.sg/covid-19/past-updates*

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Teo, J. (2021, November 8). *Singapore hospitals under significant pressure; two-thirds of ICU beds occupied.* The Straits Times. Retrieved November 25, 2021, from https://www.straitstimes.com/singapore/health/singapore-hospitals-under-significant-pressure-two-thirds-of-covid-19-icu-beds

Goh, T. (2021, November 2). *About 60% of Singapore's 219 COVID-19 ICU beds are occupied: Janil Puthucheary*. The Straits Times. Retrieved November 25, 2021, from https://www.straitstimes.com/singapore/politics/about-60-of-singapores-219-covid-19-icu-beds-occupied-janil-puthucheary.