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Misperceptions about the Impact of Lockdown on the Number of Newly Reported COVID-19 Cases

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Abstract

Thailand, along with many other countries, was hit by coronavirus disease 2019 (COVID-19). The COVID-19 vaccines were known to be effective in mitigating the spread and preventing deaths. However, Thailand faced a crisis in mid-2021 before the vaccines could disseminated to the population. Thus, the Government introduced a lockdown policy to control the outbreak. However, many questioned the effectiveness of the policy as it did not immediately result in favorable outcomes. Therefore, this study aimed to unravel results of the lockdown using deterministic system dynamics and compartmental models. We found that there was a misperception surrounding the idea that the lockdown policy could reduce the number of newly reported cases within few days. In addition, the epidemic would always continue as long as there were susceptible people remaining in the system. Therefore, the Government needs to consider other supporting policies alongside the lockdown and communicate with the wider public about its objectives.

Keywords: COVID-19, lockdown policy, compartment model, system dynamic, Thailand

Thailand and COVID-19 at a Glance

Coronavirus disease 2019 (COVID-19) has caused many unprecedented consequences to the global population, in terms of health and economic sequalae.[1, 2] Thailand is amongst many nations that have been severely hit by the COVID-19 pandemic. It was the first country outside of China to report the presence of cases.

During the first wave of the epidemic, Thailand seemed to be successful in containing the disease through various non-pharmaceutical interventions (NPI). The number of new daily cases in early 2020 never exceeded 200. By the end of the year, the cumulative number of cases was 6,884 with only 61 deaths.[3] However, after the introduction of the alpha and delta variants in 2021, the number of daily cases increased from about 200 in early April to more than 22,000 in August. This caused much concern to the society and many worried that the national health system would collapse.

The COVID-19 crisis in Thailand was exacerbated by the delay of both imported and domestically produced vaccines. Although the national Government regularly delivered campaigns to promote NPI, including social distancing, regular handwashing and face-mask wearing, it appeared that these NPI were not sufficient to contain the outbreak. As a result, the Government introduced a "lockdown" policy on 19 Jul 2021 in the epicenter (Bangkok and its vicinity). The essence of the lockdown was a strict restriction of human mobility, such as prohibition of inter-provincial travel and the closing of schools, restaurants and all public spaces, in addition to rigorous NPI on individuals (100% face-mask wearing in public places).

Prior to the lockdown, the number of cases ranged from about 11,000-12,000 per day with approximately 50-80 deaths. However, on 19 August, a month after the lockdown policy, the number of new daily cases exceeded 20,000 with around 300 deaths per day.

This worsening situation created contentious public debates with many asking if the lockdown measure should be continued. Many scholars and policymakers wondered how a lockdown policy, which has proven to be effective in the past, could be so ineffective. We, therefore, aimed to unravel this mystery through an analysis on a hypothetical dataset.

Model Analysis

We developed a compartmental epidemic model in combination with a system dynamics concept. A susceptible population would be infected once by coming into contact with infectious individuals, hereafter labeled as "exposed". Within an incubation period, the exposed individuals would become infectious. The infectious could then recover with a rate determined by the recovery time.

In any given population, the number of individuals becoming infected each day is difficult to determine accurately. The number of newly reported cases is determined from the number of positive results of the COVID-19 RT-PCR test. A person with a positive RT-PCR would be isolated. Therefore, we added the testing and isolation process into the model.

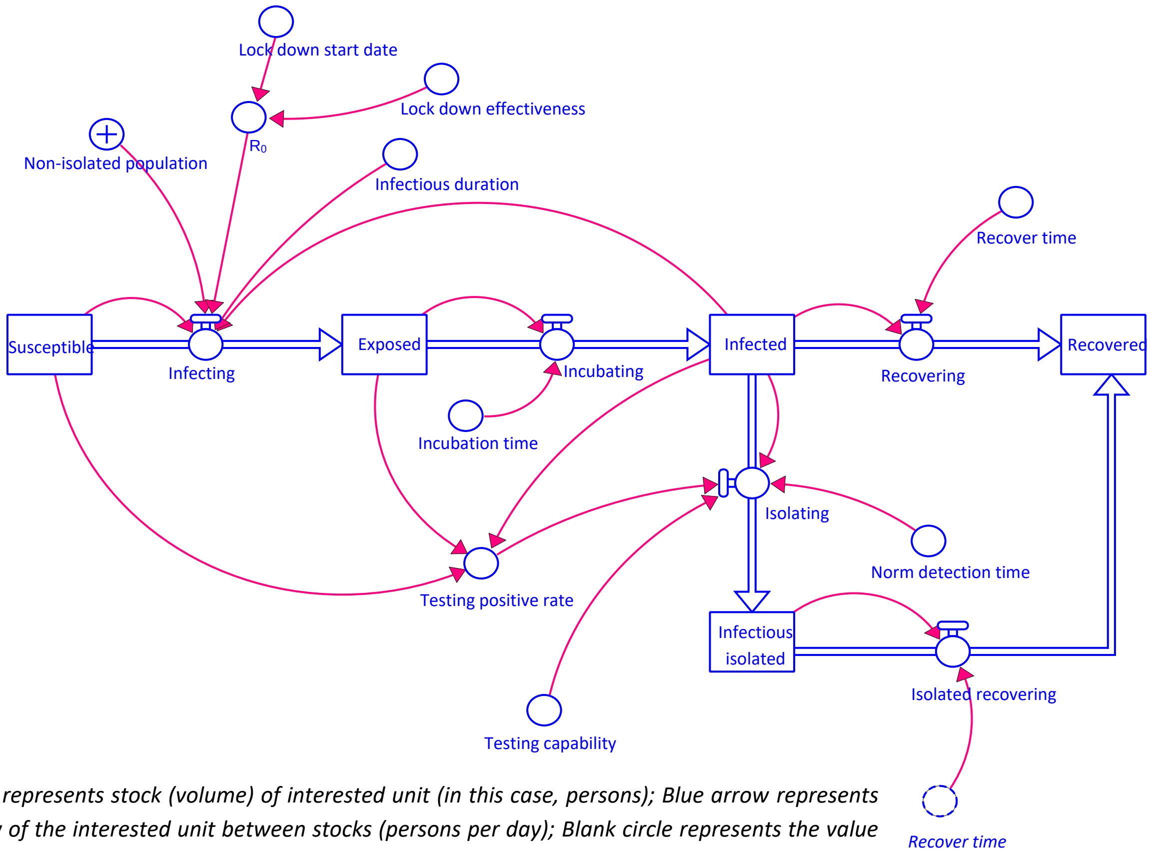
The number of newly reported cases was determined by the following factors: first, the average duration to tracing and testing, and second, the testing capacity. The impact of a lockdown was put into the model through the change in the basic reproductive number (R_0). We added the impact of the lockdown as a percentage reduction in R_0.

We set up a hypothetical dataset with various essential parameters, which are shown in Table 1, to simulate the results. The model framework is demonstrated in Figure 1.

Table 1. Essential parameters of the model

Parameter	Value	Unit
R_0 (hypothetical value)	2	Dimensionless
Number of initial infectees (hypothetical value)	5,000	Persons
Total population of Thailand	60,000,000	Persons
Recovery time†	7	Days
Testing capacity†	50,000	Persons/day
Detection time†	3	Days
Infectious duration[4]	3	Days
Incubation period[5]	5	Days

†Based on the operation of the Thai health system



Note: Box represents stock (volume) of interested unit (in this case, persons); Blue arrow represents flow of the interested unit between stocks (persons per day); Blank circle represents the value of each external variable (such as R0, infectious duration, and incubation period); Plus circle represents the value of many external variables combined (in this case, non-negative population equates the combination of susceptible, exposed and recovered groups); Red arrow represents the influence of external variable on the flow.

Figure 1. Model framework

Analysis of the Impact of a Lockdown Policy

First, we simulated a model without a lockdown policy and no NPI. Figure 2 presents the results of the model. The solid line represents the number of new daily reported cases (left axis), and the dash-dotted line represents the R_0 (right axis). The figure shows that the number of newly reported cases would increase to about 35,000 on day 75 and then gradually decrease to fewer than 10,000 on day 90.

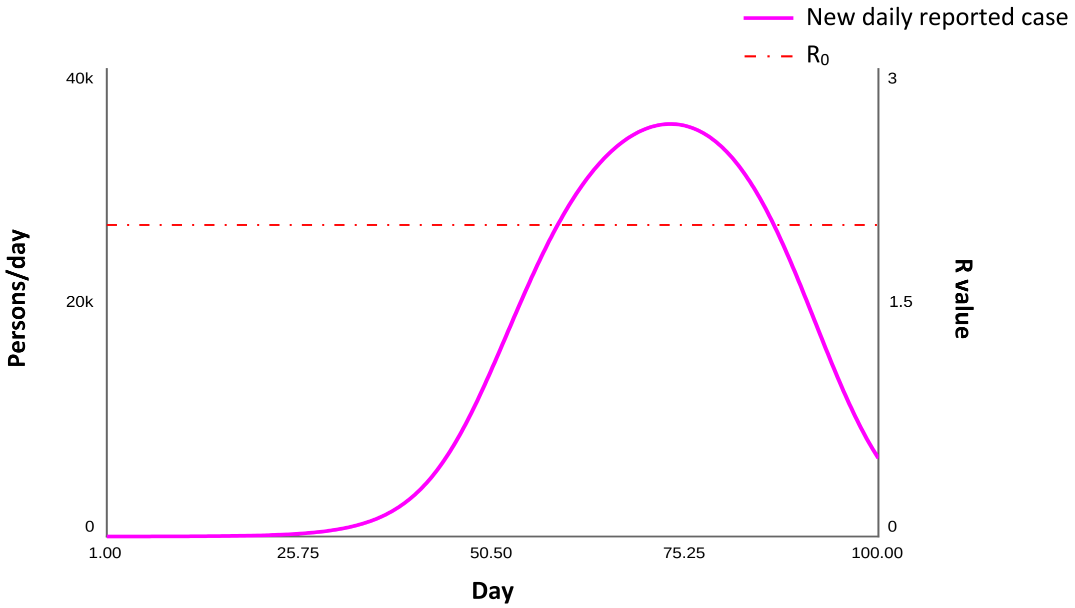


Figure 2. Distribution of new daily reported cases without a lockdown policy

We assumed that on day 45, there were 7,000 newly reported cases. We then simulated another model in which the Government implemented a lockdown policy, which would reduce the R_0 by 30%. Figure 3 presents the results of this model. The number of new daily reported cases would initially increase and reach a peak of about 25,000 cases by about day 70, 25 days after the lockdown started after which the number of cases would begin to decrease.

We performed a sensitivity analysis on the effectiveness of the lockdown policy by varying the percentage reduction in R_0 by 0%, 30%, 50%, and 70%, as shown in Figure 4. In the scenario where R_0 reduced by 50%, the new daily reported cases would reach a peak on day 68 and then start to decline. The time to observe the peak would be put off to later than day 70 with no lockdown policy, if there were susceptible people remaining in the population pool, and R_0 did not decrease below the epidemic threshold value of 1.

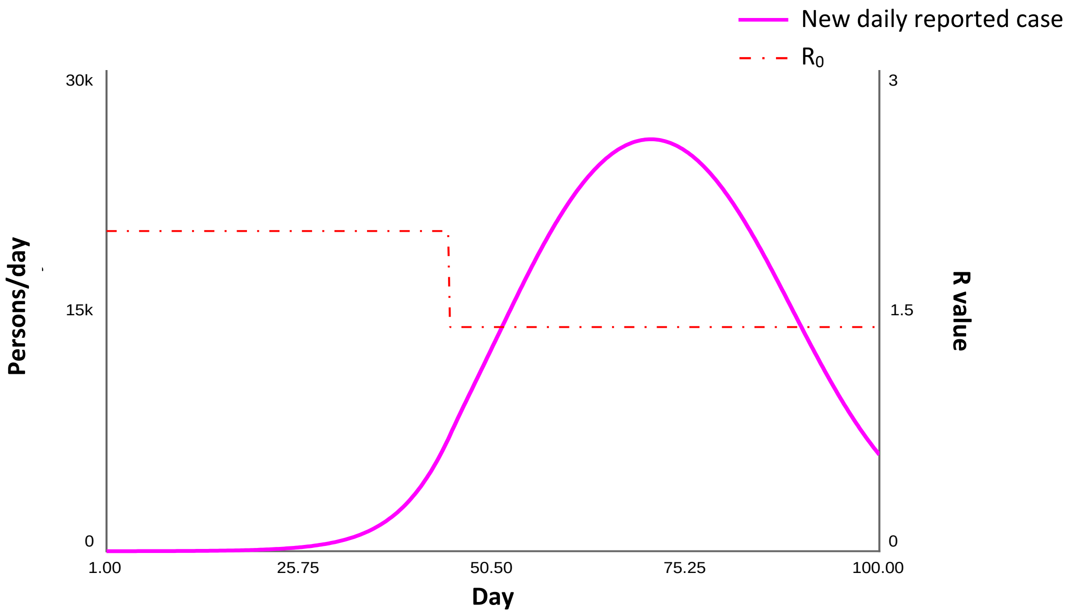
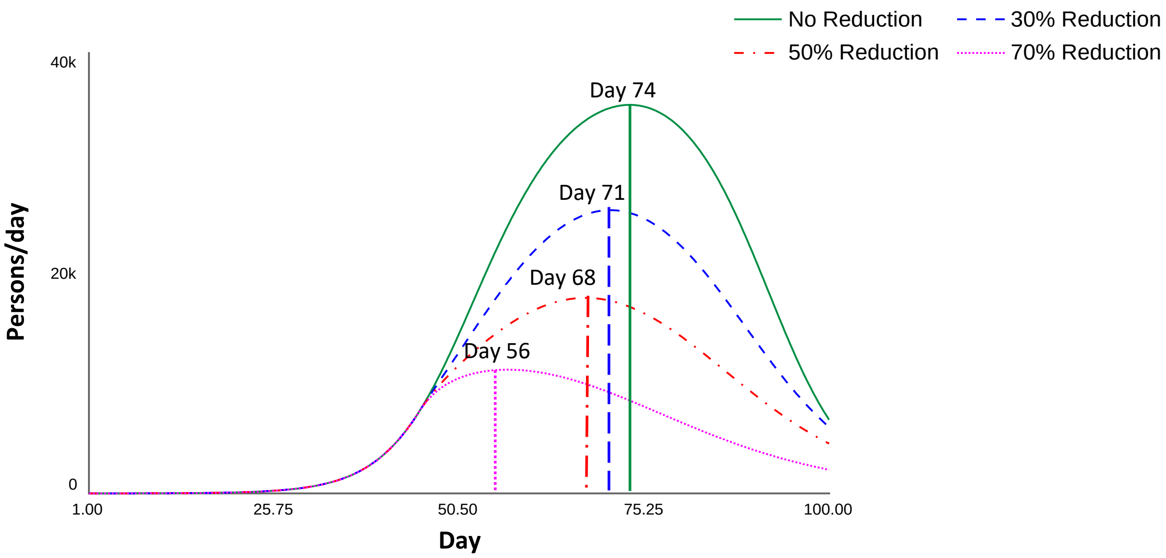


Figure 3. Distribution of new daily reported cases given the implementation of a lockdown policy (effectiveness = 30%)



Note: The peak day of the epidemic for a 0%, 30%, 50%, and 70% reduction occurred on days 74, 71, 68, and 56, respectively.

Figure 4 Distribution of new daily reported cases with the implementation of a lockdown policy by various reductions of R_0

What We have Learnt from the Analysis and Conclusion

Many believed that the lockdown policy in Thailand would reduce the number of newly reported cases within a few days. Our finding shows that this perception is incorrect. In addition, we found that as the effectiveness of the lockdown increases, the peak will not only reduce in magnitude but will occur earlier. In other words, the epidemic will always continue as long as R_0 is larger than one and as long as there is a susceptible population. The bottom line is that if the objective of the lockdown policy is "to buy time" and to delay the period when health resources are used up, the Government needs to consider other supporting policies. These may encompass a massive screening on COVID-19 like in other countries, such as China and South Korea,[6,7] or a rapid scaling up of field hospitals and intensive care units to ensure the health system is better prepared for the coming peak.[8] Thus, the Government should communicate with the wider public about the objectives of the lockdown and set a clear plan on the lockdown policy. This will help enhance the effectiveness of the policy, and at the same time, help harness the collective effort from all sectors in the society to curb the outbreak in the long run.

Ethical Approval

Not required in this study

Competing Interests

Authors declare no conflict of interests

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References

1. Maital S, Barzani E. The global economic impact of COVID-19: a summary of research [Internet]. Haifa [Israel]: Samuel Neaman Institute; 2020 Mar [cited 2021 Aug 22]. 12 p. <https://www.neaman.org.il/EN/The-Global-Economic-Impact-of-COVID-19-A-Summary-of-Research>
2. del Rio C, Collins LF, Malani P. Long-term Health Consequences of COVID-19. JAMA. 2020;324:1723–4.
3. Worldometer. Thailand Coronavirus Cases [Internet]. [place unknown]: Worldometer; [cited 2021 Aug 21]. <https://www.worldometers.info/coronavirus/country/thailand/>
4. Johansson MA, Quandelacy TM, Kada S, Prasad PV, Steele M, Brooks JT, et al. SARS-CoV-2 transmission from people without COVID-19 symptoms. JAMA Netw Open. 2021 Jan;4(1):e2035057. doi: 10.1001/jamanetworkopen.2020.35057.
5. McAloon C, Collins A, Hunt K, Barber A, Byrne AW, Butler F, et al. Incubation period of COVID-19: a rapid systematic review and meta-analysis of observational research. BMJ Open. 2020 Aug 16;10(8):e039652. doi: 10.1136/BMJOPEN-2020-039652.

6. Kwon KT, Ko JH, Shin H, Sung M, Kim JY. Drive-through screening center for COVID-19: a safe and efficient screening system against massive community outbreak. J Korean Med Sci. 2020 Mar 23; 35(11):e123.

7. Fang Y. Large-scale national screening for coronavirus disease 2019 in China. J Med Virol. 2020 Nov;92(11):2266–8.

8. Fang D, Pan S, Li Z, Yuan T, Jiang B, Gan D, et al. Large-scale public venues as medical emergency sites in disasters: lessons from COVID-19 and the use of Fangcang shelter hospitals in Wuhan, China. BMJ Glob Health. 2020 Jun;5(6):e002815.