# A Study on The Effectiveness of Lock-down Measures to Control The Spread of COVID-19

Subhas Kumar Ghosh[a,*], Sai Shanmukha Narumanchi[b], Sachchit Ghosh[c]

[a] *Commonwealth Bank of Australia, Sydney, New South Wales, 2000, Australia*
[b] *Department of Computer Science, Southern Illinois University, Carbondale, IL 62901, USA.*
[c] *The University of Sydney, Camperdown, NSW 2006, Australia*

---

**Abstract**

*Keywords:* COVID-19, Lock down, Mathematical modeling, Epidemic, Economic Impact

---

## 1. Introduction

In December 2019, an outbreak occurred in Wuhan, China involving a zoonotic coronavirus, similar to SARS coronavirus and MERS coronavirus [1]. The virus has been named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), and the disease caused by the virus has been named the coronavirus disease 2019 (COVID-19). Since then the ongoing pandemic has infected more than 9 million people and has caused more than 467 thousand deaths worldwide.

Since the initial outbreak, several different studies have tried to estimate the number of infections [2] that stem from a single infected patient in order to predict the potential for transmission of the COVID-19 virus. In most cases, it was seen that $R_0 > 1$, implying exponential growth through infection of a vulnerable population. Original estimates placed mortality rates for individuals at high risk at 4.46 % with those suffering from cardiovascular or kidney disease having even greater susceptibility [3].

*Corresponding author

*Email addresses:* subhas.ghosh@cba.com.au (Subhas Kumar Ghosh), sai@cs.siu.edu (Sai Shanmukha Narumanchi), sgho2841@uni.sydney.edu.au (Sachchit Ghosh)

The SARS-CoV-2 virus has no available treatment as the pathways for proliferation and pathogenesis are still unclear [4]. Current treatments are based on those effective on strains of the previous SARS coronavirus and MERS coronavirus. The SARS-CoV-2 virus is able to replicate rapidly during the asymptomatic phase and affect the lungs and respiratory tract, resulting in pneumonia, hypoxia, and acute respiratory distress [5]. To reduce

Under the conditions at the time, with a highly pathogenic SARS-CoV-2 that is able to spread asymptomatically during its incubation stage through a vulnerable population, policymakers were to contain the spread of the infection, minimize stress on the health systems and ensure public safety. This was done by issuing orders for widespread lockdown and implementing social distancing measures. All non-essential businesses and services were shut down until further notice.

The impact of this lockdown directly

Motivate the requirements for analyzing effectiveness of lock-down. What were the benefits? Reducing burden on healthcare system, saving loss of life, and reducing $R_0$ by breaking transmission chain.

How can we measure these benefits and compare with the economic losses?

### *1.1. Our contribution*

Defining how to measure these benefits.

Tools for measuring them.

Difficulty in assessing: different level of compliance, different cultural practices - hidden variables

### *1.2. Related Works*

Other modeling approaches. SIR-F, DCM, Agent, Hybrid - not post fact A/B testing tools.

### *1.3. Tools*

$m - RSC$ [6, 7], Trend analysis,

## 2. The setup

Data - Data Source - Dims [infected, fatal, recovered, No of tests]

## 3. Results

India - 4 stages of lock-down - effect of each stages - results on prediction by Synthetic control

Singapore - recurrence - change in projection on those dates

US - compare prediction models data vs. Synthetic control projection vs actual by state by start and end of lock-down dates (what are the control group in each cases)

AU NZ South K

Sweden

Measured results.

## 4. Discussion

## 5. Concluding Remarks

## References


[1] Y. Liu, A. A. Gayle, A. Wilder-Smith, J. Rocklöv, The reproductive number of covid-19 is higher compared to sars coronavirus, Journal of Travel Medicine 27 (2). doi:10.1093/jtm/taaa021.
URL `https://doi.org/10.1093/jtm/taaa021`

[2] G. Viceconte, N. Petrosillo, Covid-19 r0: Magic number or conundrum?, Infectious disease reports 12 (1) (2020) 8516–8516.
URL `https://pubmed.ncbi.nlm.nih.gov/32201554`

[3] A. Banerjee, L. Pasea, S. Harris, A. Gonzalez-Izquierdo, A. Torralbo, L. Shallcross, M. Noursadeghi, D. Pillay, N. Sebire, C. Holmes, C. Pagel, W. K. Wong, C. Langenberg, B. Williams, S. Denaxas, H. Hemingway, Estimating excess 1-year mortality associated with the covid-19 pandemic according to underlying conditions and age: a population-based cohort study, The Lancet 395 (10238) (2020) 1715–1725.

[4] A. Rismanbaf, Potential treatments for covid-19; a narrative literature review, Archives of academic emergency medicine 8 (1) (2020) e29–e29.

[5] S. Price, S. Singh, S. Ledot, P. Bianchi, M. Hind, G. Tavazzi, P. Vranckx, Respiratory management in severe acute respiratory syndrome coronavirus 2 infection, European Heart Journal: Acute Cardiovascular Care

9 (3) (2020) 229–238. doi:10.1177/2048872620924613.
URL `https://doi.org/10.1177/2048872620924613`

[6] A. Abadie, A. Diamond, J. Hainmueller, Synthetic control methods for comparative case studies: Estimating the effect of california's tobacco control program, Journal of the American Statistical Association 105 (490) (2010) 493–505. doi:10.1198/jasa.2009.ap08746.

[7] M. Amjad, D. Shah, D. Shen, Robust synthetic control, Journal of Machine Learning Research 19 (22) (2018) 1–51.
URL `http://jmlr.org/papers/v19/17-777.html`