Economic Evaluations of Public Health Interventions on COVID-19: A Systematic Review

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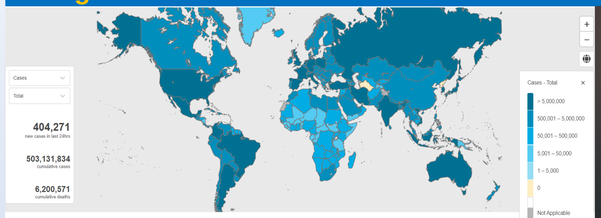
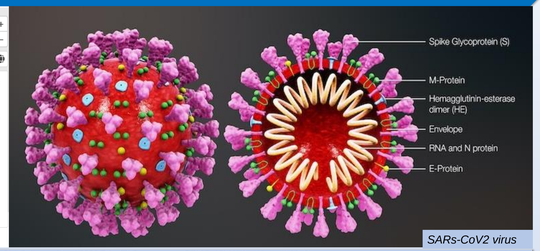
Background





SARs-CoV2 virus

Globally, as of **5:40pm CEST, 19 April 2022**, there have been **503,131,834 confirmed cases** of COVID-19, including **6,200,571 deaths**, reported to WHO. As of **17 April 2022**, a total of **11,324,243,310 vaccine doses** have

Sources: WHO. WHO Coronavirus (COVID-19) Dashboard 2022 [Available from: https://covid19.who.int/.]; Coronavirus (COVID-19) Updates: San Diego City College; [cited 2022 7 April]. Coronavirus (COVID-19) Updates]. Available from: http://sdcity.edu/about/communications/covid19/.

- The COVID-19 pandemic has been one of the greatest public health challenges imposing significant economic and societal costs.
- Governments worldwide have implemented drastic policy measures to contain the transmission of the virus, of which have caused economic downturn and social calamity.
- There is paucity of data on the full economic cost (EEs) and cost-effectiveness of different policy measures currently used in containing the spread of COVID-19.

Objectives

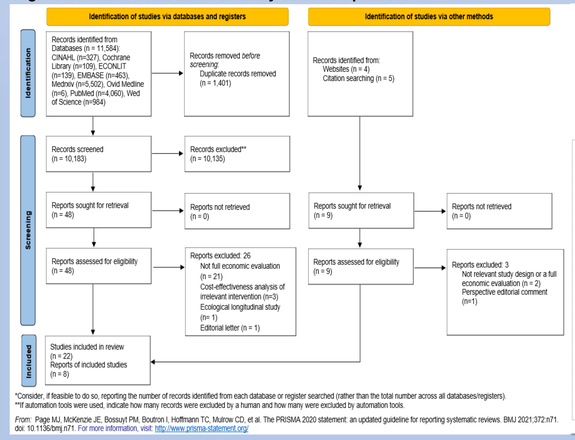
- This systematic review was conducted to summarize the existing evidence on the cost and cost-effectiveness of a range of policy measures used to contain COVID-19 transmission to inform decisions concerning their adoptions.

Methods

- We searched seven relevant databases (CINAHL, The Cochrane Library, ECONLIT, EMBASE, Medrivx, PubMed, and Web of Science) and other sources using the MeSH terms "((COVID* OR COVID-19 OR COVID19 OR (SARs-CoV-2)) AND (economic OR cost-effectiveness analysis OR cost-benefit OR cost-utility OR cost-effectiveness)" without language restriction from 2019 up until 19 March 2021.
- The primary outcome was incremental cost-effectiveness ratio (ICER) per any health outcome unit gain or averted.
- Articles were included if they (1) contained a full EE on public health interventions (PHIs) in response to COVID-19 control and prevention; (2) included comparison of PHIs with do nothing or other alternative strategies; and (3) had at least one of outcome of interests.
- One reviewer performed searching and initial screening which were checked for the inclusion/exclusion criteria independently by another two reviewers who extracted data, and critically appraised the study quality using the Drummond 10-point checklist guidelines which were confirmed by the third reviewer.

Results

Figure 1 PRISMA flow chart of study selection process

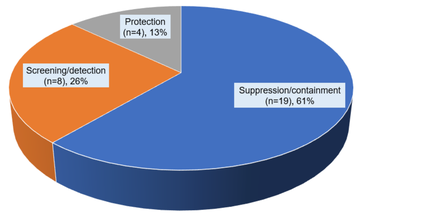


*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

- Out of 11,595 records identified, a total 31 full EEs focusing on public health interventions (PHIs) were included.
- Majority of studies included were in good quality and from the US and upper-middle, and high-income countries whereas only 6 studies were from low and middle-income countries.
- Suppression/containment was the most deployed strategy (n=19), followed by screening/detection (n = 8), and protection (n = 4).

Figure 2 Categorization of PHI stratgies employed



Results (Con't)

- Thirteen studies conducted cost-effectiveness analysis (CEA), eight and seven studies performed a cost utility analysis (CUA), and cost benefit analysis (CBA) respectively while 3 studies employed both CUA and CEA.
- The time horizon ranged from 30 days to 30 years and willingness to pay (WTP) thresholds used ranged from $3,250 to $200,000.
- Twelve and six studies used a societal and health system perspectives, respectively whereas three studies used both. The perspective used was not specified in ten studies,

Table 1 Sensitivity analyses

No	Author, Year	Country	1-way	2-way	3-way	PSA	CEAC	Scenario
1	Atkeson, et al 2021	USA	•					•
2	Baggett, TP. et. al. 2020	USA	•	•				•
3	Du, Z. et al. 2021	USA					•	•
4	Jiang, Y. et al. 2020	China	•					
5	Losina, E. et al. 2020	USA	•					•
6	Neilan, AM. et al. 2020	USA	•			•		
7	Paltiel, AD. et al. 2020	USA						•
8	Zafari, Z. et al. 2020	USA	•			•		•
9	Asamoah, JKK. et al. 2020	Ghana	•					
10	Blakely, T. et al. 2021	Australia	•				•	•
11	Broughel, J. et al. 2021	USA						•
12	Dutta, M. et al. 2020	India						•
13	Gandjour, A. 2020	Germany	•					•
14	Khajji, B. et al. 2020*	Morocco						
15	Miles, DK. et al. 2021	UK						•
16	Mol, B and Karnon, J 2020	Sweden and Denmark	•					
17	Padula, WV. et al. 2020	USA	•			•		
18	Reddy, KP. et al. 2021	South Africa	•			•		
19	Scherbina, A. 2020	USA						•
20	Schonberger, RB. et al. 2020*	USA						
21	Sharma, N. et al. 2020*	India						
22	Shlomai, A. et al. 2020	Israel	•			•		
23	Thunstrom, L. et al 2020	USA	•					•
24	Wang, Q. et al. 2020	China	•	•				•
25	Xu, L. et al. 2020	China	•					•
26	Zala, D. et al 2020	UK	•					•
27	Zhao, J. et al. 2021	China	•			•		
28	Bagepally, BS. et al. 2021	India	•			•		
29	Ebigbo, A. et al. 2021	Germany				•		•
30	Risko, N. et al. 2020	LMICs				•		•
31	Savitsky, LM. et al. 2020	USA	•	•		•		•

Note: CEAC, cost-effectiveness acceptability curve; LMICs, Low- and Middle-income Countries; PSA, probability sensitivity analysis; *Not reported

Table 2 Risk of Bias Assessment

No	Author, Year	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Screening/detection											
1	Atkeson et al 2021	+	+	?	?	+	+	−	+	+	−
2	Baggett et al. 2020	+	+	+	+	+	+	−	+	+	+
3	Du et al. 2021	+	+	−	+	+	+	−	+	+	+
4	Jiang et al. 2020	+	+	−	?	+	+	+	+	+	+
5	Losina et al. 2020	+	+	+	+	+	+	−	+	+	+
6	Neilan et al. 2020	+	+	+	?	+	+	+	+	+	+
7	Paltiel et al.2020	+	+	−	+	+	+	−	+	+	+
8	Zafari et al. 2020	+	+	+	+	+	+	−	+	+	+
Suppression/containment											
9	Asamoah et al. 2020	+	+	+	−	−	−	−	+	−	−
10	Blakely et al. 2021	+	+	+	+	−	+	−	+	+	+
11	Broughel et al. 2021	+	+	+	+	+	+	+	+	+	−
12	Dutta et al. 2020	+	+	+	-	+	+	−	+	-	−
13	Gandjour 2020	+	+	−	?	+	+	−	+	+	+
14	Khajji et al. 2020	+	+	−	?	+	+	−	+	−	−
15	Miles et al. 2021	+	+	+	-	+	+	−	+	+	−

No	Author, Year	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
16	Mol and Karnon 2020	+	+	+	+	−	+	−	+	+	+
17	Padula et al. 2020	+	+	+	+	+	+	+	+	+	+
18	Reddy et al. 2021	+	+	+	+	+	+	−	+	+	+
19	Scherbina et. al. 2020	+	+	-	+	+	+	−	+	+	+
20	Schonberger et al. 2020	+	+	?	?	+	?	+	−	−	−
21	Sharma and Mishra 2020	+	+	?	?	+	+	−	−	−	−
22	Shlomai et al. 2020	+	+	+	+	+	+	−	+	+	+
23	Thunstrom et al 2020	+	+	+	?	+	+	−	+	+	+
24	Wang et al.2020	+	+	−	+	+	+	−	+	+	+
25	Xu et al. 2020	+	+	−	−	+	−	−	+	+	+
26	Zala et. al. 2020	+	+	-	+	+	+	−	+	+	+
27	Zhao et al 2021	+	+	+	+	+	+	+	+	+	+
Protection											
28	Bagepally et al. 2021	+	+	+	+	+	+	−	+	+	+
29	Ebigbo et al. 2021	+	+	−	?	+	+	−	+	+	+
30	Risko et. al. 2020	+	+	+	+	+	+	−	+	+	+
31	Savitsky et al. 2020	+	+	+	+	+	+	−	+	+	+

Note: Plus signs represent yes (low risk of bias); minus signs, no (high risk of bias); question marks, unclear (unclear risk of bias)

- Most studies performed one-way sensitivity analysis, three of which also conducted 2-way sensitivity.
- Probabilistic sensitivity analyses (PSAs) were carried out in 10 studies
- Nineteen studies used scenario analyses in which only two and one studies provided cost-effectiveness acceptability curves (CEACs) and break-even analysis respectively.
- Three studies did not report sensitivity analyses
- According to the Drummond 10-point checklist, 21 of economic evaluations included were rated 8 to 10 indicating the methodology and analyses used were of high quality. The others were rated score of 4 to 7 and classified as average quality.
- Early adoption of effective interventions at the beginning of pandemic is essential to yield high cost-effectiveness.
- Adoption of a combination of strategies appears to be more effective compared to a single strategy.

Conclusions

- The trade-off between aggressive and loose suppressions depends on several factors including timing of implementation, duration, epidemiological characteristics of the virus, and the healthcare capacity.
- Timely adoption of PHIs is essential to achieve high cost-effectiveness.
- Factors including timing, duration, epidemiological characteristics of the virus, and the healthcare capacity should be considered upon policy implementation.
- Future research should include more rigorous EEs considering societal aspect.

References

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2. Rezapour A, Souresrafil A, Peighambari MM, Heidarali M, Tashakori-Miyanroudi M. Economic evaluation of programs against COVID-19: A systematic review. Int J Surg. 2021;85:10-8. Epub 2020/11/24. doi: 10.1016/j.ijsu.2020.11.015. PubMed PMID: 33227532; PubMed Central PMCID: PMCPMC7679235.