Supplementary appendix

Cost-effectiveness of public health strategies on COVID-19 control: A systematic review

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Online Supplementary Content

Appendix 1: The search strings used

PubMed
Search: ((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)

(("covid*"[All Fields] OR ("covid 19"[All Fields] OR "covid 19"[MeSH Terms] OR "covid 19 vaccines"[All Fields] OR "covid 19 vaccines"[MeSH Terms] OR "covid 19 serotherapy"[All Fields] OR "covid 19 serotherapy"[Supplementary Concept] OR "covid 19 nucleic acid testing"[All Fields] OR "covid 19 nucleic acid testing"[MeSH Terms] OR "covid 19 serological testing"[All Fields] OR "covid 19 serological testing"[MeSH Terms] OR "covid 19 testing"[All Fields] OR "covid 19 testing"[MeSH Terms] OR "sars cov 2"[All Fields] OR "sars cov 2"[MeSH Terms] OR "severe acute respiratory syndrome coronavirus 2"[All Fields] OR "ncov"[All Fields] OR "2019 ncov"[All Fields] OR (("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields] OR "cov"[All Fields]) AND 2019/11/01:3000/12/31[Date - Publication])) OR ("covid 19"[MeSH Terms] OR "covid 19"[All Fields] OR "covid19"[All Fields]) OR ("sars cov 2"[MeSH Terms] OR "sars cov 2"[All Fields] OR "sars cov 2"[All Fields])) AND ("economical"[All Fields] OR "economics"[MeSH Terms] OR "economics"[All Fields] OR "economic"[All Fields] OR "economically"[All Fields] OR "economics"[MeSH Subheading] OR "economization"[All Fields] OR "economize"[All Fields] OR "economized"[All Fields] OR "economizes"[All Fields] OR "economizing"[All Fields] OR ("cost benefit analysis"[MeSH Terms] OR ("cost benefit"[All Fields] AND "analysis"[All Fields]) OR "cost benefit analysis"[All Fields] OR ("cost"[All Fields] AND "effectiveness"[All Fields] AND "analysis"[All Fields]) OR "cost effectiveness analysis"[All Fields]) OR ("cost benefit analysis"[MeSH Terms] OR ("cost benefit"[All Fields] AND "analysis"[All Fields]) OR "cost benefit analysis"[All Fields] OR ("cost"[All Fields] AND "benefit"[All Fields]) OR "cost benefit"[All Fields]) OR "cost-utility"[All Fields] OR ("cost benefit analysis"[MeSH Terms] OR ("cost benefit"[All Fields] AND "analysis"[All Fields]) OR "cost benefit analysis"[All Fields] OR ("cost"[All Fields] AND "effectiveness"[All Fields]) OR "cost effectiveness"[All Fields]))) AND ((journalarticle[Filter]) AND (fft[Filter]) AND (humans[Filter]) AND (2019:2021[pdat]))

Web of Science
((COVID-19 OR COVID19 OR (SARs-CoV-2)) AND (economic OR cost-effectiveness analysis OR cost-benefit OR cost-utility OR cost-effectiveness))
Refined by: DOCUMENT TYPES: (ARTICLE) AND PUBLICATION YEARS: (2021 OR 2020 OR 2019) AND DOCUMENT TYPES: (ARTICLE) AND WEB OF SCIENCE CATEGORIES: (ECONOMICS OR POLITICAL SCIENCE OR LAW OR HEALTH CARE SCIENCES SERVICES OR PUBLIC ADMINISTRATION OR MANAGEMENT OR HEALTH POLICY SERVICES OR INFECTIOUS DISEASES) AND DOCUMENT TYPES: (ARTICLE)
Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, ESCI.

((COVID-19 OR COVID19 OR (SARs-CoV-2)) AND (economic OR cost-effectiveness analysis OR cost-benefit OR cost-utility OR cost-effectiveness))
Refined by: DOCUMENT TYPES: (ARTICLE) AND WEB OF SCIENCE CATEGORIES: (ECONOMICS OR HEALTH CARE SCIENCES SERVICES OR POLITICAL SCIENCE OR MANAGEMENT OR HEALTH POLICY SERVICES OR LAW OR INFECTIOUS DISEASES OR PUBLIC ADMINISTRATION)
Timespan: 2019-2021. Indexes: SCI-EXPANDED, SSCI, A&HCI, ESCI

MedRxiv
((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)

limit 4 to (full text and yr="2019 -2021")
Search terms used: covid covid 19 covid19 sars cov 2 economic cost effectiveness cost benefit cost utility cost effectiveness analysis Search Returned: 6 text results

The Cochrane Library
(COVID-19 OR COVID19 OR (SARs-CoV-2)) AND (economic OR cost-effectiveness analysis OR cost-benefit OR cost-utility OR cost-effectiveness)

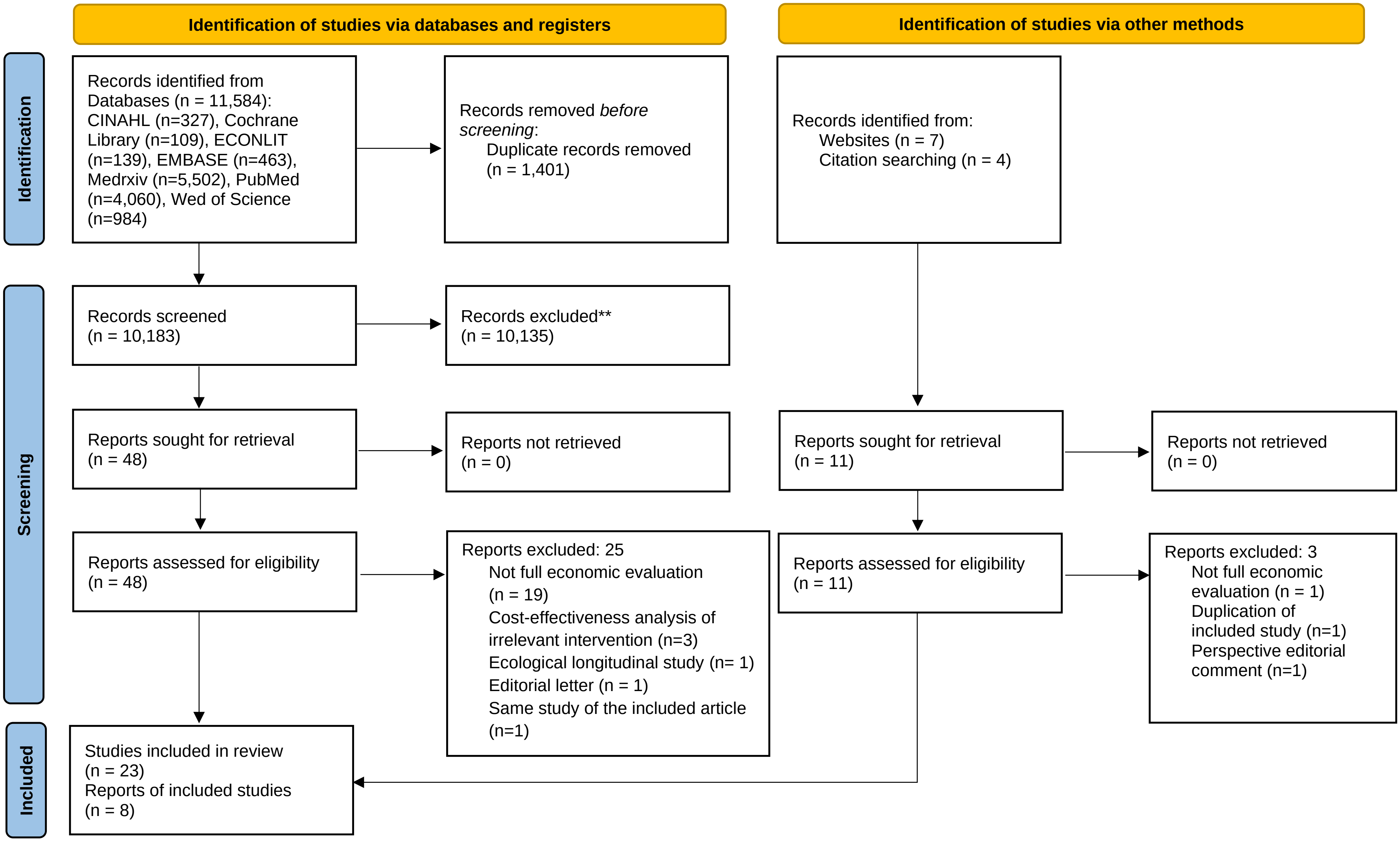
CINAHL
((COVID* OR COVID-19 OR COVID19 OR (SARs-CoV-2)) AND (economic OR cost-effectiveness analysis OR cost-benefit OR cost-utility OR cost-effectiveness)
Find all my search terms: ((COVID* OR COVID-19 OR COVID19 OR (SARs-CoV-2)) AND (economic OR... Expanders XApply equivalent subjects Limiters XFull Text XPublished Date: 20190101-20211231 XResearch Article

ECONLIT
COVID-19 or COVID19 or SARs-CoV-2
economic analysis OR cost-effectiveness analysis OR cost-benefit OR cost-utility OR cost-effectiveness)

EMBASE
COVID-19 or COVID19 or SARs-CoV-2
economic analysis OR cost-effectiveness analysis OR cost-benefit OR cost-utility OR cost-effectiveness)

Keywords: "((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)"	
Up to 19 March 2021	
Databases	**HITS**
CINAHL	327
Cochrane Library	109
ECONLIT	139
EMBASE	463
Medrxiv	5,502
PubMed	4,060
Web of Science	984
HITs	11,584
Duplicates	1,401
Total HITs	10,183

Appendix 2 Flow diagram of search strategy and study selection.



Appendix 3 Details of 28 studies excluded after full-text review

Reason for exclusion	Author
Not full economic evaluation	Bhutta, ZA, et. al. 2020[1]
	Childs, ML, et. al. 2020[2]
	Chowdhury, R, et. al 2020[3]
	Courtemanche, C, et. al. 2020[4]
	Das, A, et. al. 2020[5]
	de Oliveira, CA. 2020[6]
	Di Domenico, L, et. al. 2020[7]
	Erandi, KKWH, et. al. 2020[8]
	Glass, DH. 2020[9]
	Hernandez, A, et. al. 2020[10]
	Hyafil, A, et. al. 2020[11]
	Jardim, L, et. al. 2020[12]
	Kadyrov, S, et. al. 2020[13]
	Kohanovski, I, et. al. 2020[14]
	Lemaitre, JC, et al. 2020[15]
	Min, KD, et al. 2020[16]
	Nannyonga, BK, et al. 2020[17]
	Ricoca, PV, et al. 2020[18]
	VoPham, T, et al. 2020[19]
	Mulligan, CB. 2020[20]
Ecological longitudinal study	Piovani. D, et al. 2021[21]
Cost-effectiveness analysis of irrelevant intervention	Gandjour, A. 2020[22]
	Jiang, X, et al. 2020[23]
	Shaker, MS, et al. 2020[24]
Editorial letter/comment	Sriwijitalai, W, et. al. 2020[25]
	Gandhi, M, et. al. 2020[26]
Same/duplication of included studies	Atkeson, A, et al. 2020[27]
	Miles, D, et. al. 2020[28]

Appendix 4 Summary of key findings of included studies

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
Screening/detection								
1	Atkeson et al. 2021[27]	USA	Strategy 1. 10-day screening testing Strategy 2. 5-day screening testing Strategy 3. 3-day screening testing *Note:* A sensitivity of 90% and specificity of 99.5% were assumed for rapid antigen test with 50% of those testing positive receive RT-PCR. Adherence to self-isolation among those testing positive was 50%.	No additional screening test	NR	NR	The timing of the introduction of the testing program has a large impact on the program's net benefits and additional lives saved. The program averts between 28,000 to 91,000 deaths and an increase in GDP between $8 to $46 billion.	6
2	Baggett, TP. et al. 2020[29]	USA	1. Symptom screening, PCR, and hospital 2. Symptom screening, PCR, and ACS 3. Universal PCR testing and hospital 4. Universal PCR and ACS 5. Universal PCR and temporary housing 6. Hybrid hospital 7. Hybrid ACS	No intervention: only basic infection control practices are implemented in shelters	At R0 2.6, ICERs vs. no intervention per case prevented: 1. ICER Symptom screening, PCR, and hospital = $7,943.97 2. ICER Symptom screening, PCR, and ACS = $-3,959.44 3. ICER Universal PCR testing and hospital = $24,785.45 4. ICER Universal PCR and ACS = -$7,161.17 5. ICER Universal PCR and temporary housing = $20,925.86 6. ICER Hybrid hospital = $6,184.40 7. ICER Hybrid ACS = $-2,549.02	NR	Daily symptom screening and use of ACSs among individuals with pending test results and mild to moderate COVID-19 patients was the most efficient strategy and cost-saving relative to no intervention across all epidemic scenarios.	9

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
3	Du, Z. et al. 2021[30]	USA	Strategy 1: Daily antigen test plus 1-week isolation Strategy 2: Daily antigen test plus 2-week isolation Strategy 3: Antigen test every 7 days plus 1-week isolation. Strategy 4: Antigen test every 7 days plus 2-week isolation. Strategy 5: Antigen test every 14 days plus 1-week isolation. Strategy 6: Antigen test every 14 days plus 2-week isolation. Strategy 7: Antigen test every 28 days plus 1-week isolation. Strategy 8: Antigen test every 28 days plus 2-week isolation.	Symptom-based testing and isolation (status-quo strategy)	Under a rapid transmission scenario (Re of 2·2) (Base-case): ICER 7-day testing, 2-week isolation = $31,266.67 per YLL averted Median incremental net monetary benefits ($ billion) = 2,378 (ranges 264,4292) Under low transmission scenarios (Re of 1·2): ICER 28-day testing, 1-week isolation = $52,500 per YLL averted Median incremental net monetary benefits ($ billion) = 257 (-845,1506)	$100,000 per YLL averted	Under a rapid transmission scenario (Re of 2·2), the strategy most likely to be cost-effective is weekly testing followed by a 2-week isolation period subsequently to a positive test result. Under low transmission scenarios (Re of 1·2), monthly testing of the population followed by 1-week isolation rather than 2-week isolation is likely to be most cost-effective. Expanded surveillance testing is more likely to be cost-effective than the status-quo testing strategy if the price per test is less than $75.	8
4	Jiang et al. 2020[31]	China	Three reverse transcription-PCR (RT-PCR) tests	Two reverse transcription-PCR (RT-PCR) tests	ICER the tree-test relative to the two-test strategy = CN¥-57,757.91 ($ -13,799.19) Net monetary benefit = CN¥ 104.0 million ($4.86 million)	64,644 CNY ($15,444)	The three-test strategy was cost-saving compared with the two-test strategy would have resulted in 850.1 QALYs of health gain and a net healthcare expenditure saving of CN¥49.1 million ($11.73 million) over the analytic period in Wuhan, amounting to an NMB of CN¥104.0 million ($24.86 million)	8
5	Losina et al. 2020[32]	USA	4 NPIs include social distancing, mask-wearing policies, isolation, and	No intervention	ICER per infection prevented compared to no intervention: 1. ICER Mask + ResIsol + self-screen = $76.02 2. ICER Extensive social distancing +	$150,000 per QALY	Extensive social distancing and mandatory mask wearing policies was cost-effective in preventing COVID-19 cases on college campuses. Laboratory	9

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
			laboratory testing in various combinations		masks + Reslsol + self-screen = $104.38 ICER Extensive social distancing + masks + Desiglsol + RLTq14 = $223.62 4. ICER Extensive social distancing + masks + Desiglsol + RLTq7 = $322.92 ICER Extensive social distancing + masks + Desiglsol + RLTq3 = $482.01 ICER per QALY gain compared to no intervention: 1. ICER Mask + Reslsol + self-screen = $17.261.98 2. ICER Extensive social distancing + masks + Reslsol + self-screen = $25,485 3. ICER Extensive social distancing + masks + Desiglsol + RLTq14 = $55,982.27 4. ICER Extensive social distancing + masks + Desiglsol + RLTq7 = $82,037.29 5. ICER Extensive social distancing + masks + Desiglsol + RLTq3 = $121,642.70		would further reduce infections but would require lower-cost tests combined with markedly increase capacity to be feasible.	
6	Neilan et al. 2020[33]†	USA	Strategy 1 PCR-severe-only Strategy 3 (Symptomatic + asymptomatic-once): Symptomatic and one-time PCR for the entire population Strategy 4: Symptomatic + monthly testing	Strategy 2 (Symptomatic): Hospitalized and PCR COVID-19-consistent symptoms with self-isolation	<u>Slowing Scenario (Re = 0.9)</u> ICER Strategy 1 = dominated ICER Strategy 3 = $194,000/QALY ICER Strategy 4 = $908,000/QALY <u>Intermediate Scenario (Re = 1.3)</u> ICER Strategy 1 = $110,000/QALY ICER Strategy 3 = dominated ICER Strategy 4 = $908,000/QALY <u>Surging Scenario (Re = 2.0)</u> ICER Strategy 1 = dominated	$100,000/QALY	Universal screening with monthly retesting would be cost-effective at effective reproduction numbers (Re) ≥1.8; at lower Re, restricting testing to those with any symptoms would be economically preferred.	9

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
			Note: PCR sensitivity of 70% and specificity of 100% were assumed.		ICER Strategy 3 = dominated ICER Strategy 4 = $33,000/QALY			
7	Paltiel et al. 2020[34]	USA	1. Weekly screening 2. Screening every 3 days 3. Screening every 2 days 4. Daily	Symptom-based screening	Base-case scenario (Rt 2.5, 10 exogenous shock infections/wk) with a US$25 test at 70% sensitivity: ICER weekly = $200/infection averted ICER every 3 days = $600/infection averted ICER every 2 days = $5,700/infection averted ICER daily = $28,400/infection averted Worst case scenario (Rt 3.5, 25 exogenous shock infections/wk) with a US$25 test at 70% sensitivity: ICER weekly = dominated ICER every 3 days = dominated ICER every 2 days = $600/infection averted ICER daily = US$4,400/infection averted Best case scenario (Rt 1.5, 5 exogenous shock infections/wk, 99.7% specific test) with a US$25 test at 70% sensitivity: ICER weekly = $700/infection averted ICER every 3 days = $9,100/infection averted ICER every 2 days = $38,800/infection averted ICER daily = $128,100/infection averted	Base case scenario: $8,500/infection averted Worst case scenario: $11,600/infection averted Best case scenario: $5,500/infection averted	Base-case scenario (Rt 2.5, 10 exogenous shock infections/wk): screening every 2 days with a 70% sensitivity test was the preferred strategy Worst-case scenario (Rt 3.5, 25 exogenous shock infections/wk): daily screening with a 70% sensitivity test was the optimal strategy Best-case scenario (Rt 1.5, 55 exogenous shock infections/wk): weekly screening with a 70% sensitivity test was the optimal strategy. Screening with less sensitive test is dominated screening with more expensive and accurate test for all WTP values. Specificity is matter far more than sensitivity which results in overwhelming number of false positives and isolation housing capacity.	8

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
8	Zafari et al. 2020[35]	USA	CDC guidelines +additional screening and preventive measures include: 1. Symptom-checking mobile application 2. Standardizing mask 3. Thermal imaging camera 4. One-time testing for SARS-CoV2 on entry 5. Weekly testing for SARS-CoV2 6. Upgrades to ventilation systems or installation of far-ultraviolet C lighting systems	CDC guidelines (social distancing, protective measures, and maintaining a healthy environment alone)	At prevalence rate 0.1% - Symptom checking application would be cost-saving (ICER = -$684.21 per QALY gained) - Gateway testing ICER=$40.9m /QALY gained - Weekly testing ICER=$60.7m /QALY gained - 2-ply mask ICER=$1.44m/QALY gained - Thermal imaging ICER=$58.9m /QALY gained At prevalence rate 1% - Symptom checking application would be cost-saving (ICER = -$107k/0.057 per QALY gained) - Gateway testing ICER=$19.4m /QALY gained - Weekly testing ICER=$2.52m /QALY gained - 2-ply mask would be cost-saving ICER = -$780k/0.48 - Thermal imaging (ICER=$2.36m /QALY gained) At prevalence rate 2% - Symptom checking application would be cost-saving (ICER = -$32.6k/0.035 per QALY gained) - Gateway testing ICER=$1.08m /QALY gained - Weekly testing ICER=$820m /QALY gained - 2-ply mask (Dominant*), ICER=-$335k/0.46 per QALY gained - Thermal imaging, ICER=$965m /QALY gained	$200,000/QALY	In 3 scenarios: 1. At "Low prevalence" (New York City), at a prevalence of 0.1%, symptom checking application is cost-saving relative to CDC guidelines alone. 2. At "moderate prevalence" (Texas), at a prevalence of 1%, standardizing masks will be cost saving. 3. At "high prevalence" (Florida), at a prevalence rate of 2%, symptom checking application and 2-ply mask are cost-saving, but the university would likely close after 18 days.	9

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
Suppression/containment								
9	Asamoah et al. 2020[36]	Ghana	Strategy 1, u1 only (The effective testing and quarantine when borders are opened. Strategy 2, u2 only (Intensifying the usage of nose masks and face shields through education.) Strategy 3, u3 only (Cleaning of surfaces with home-based detergents.) Strategy 5, u5 only (Fumigating commercial areas such as markets. Strategy 6, combines the use of control ui, i = 1,..,5	Strategy 4, u4 only (Safety measures adopted by asymptomatic and symptomatic individuals such as practicing proper cough etiquette)	ICER Strategy 1 = \$2.5671 x 10^{-10} ICER Strategy 2 = \$7.4180 x 10^{-11} ICER Strategy 3 = \$1.5464 x 10^{-8} ICER Strategy 5 = \$1.0691 x 10^{-10} ICER Strategy 6 = dominated	NR	Safety measures such as properly cough etiquette, social distancing, hand washing (Strategy 4) is the most cost-effective strategy, followed by the usage of nose mask and face shields through education (strategy 2), the effective testing and quarantine when boarders are opened (strategy 1), fumigating the commercial areas such as markets (strategy 5), cleaning of surfaces with home-based detergents (strategy 3), and combination of all control interventions of strategy 1 to 5 (strategy 6)	4
10	Blakely et al. 2021[37]	Australia	1. Aggressive elimination strategy 2. Moderate elimination strategy 3. Tight suppression strategy 4. Loose suppression strategy	Business-as usual or no COVID-19	NR	\$15,000 per HALY	Health system perspective: Aggressive elimination was optimal (64% of simulations), followed by moderate elimination (35% of simulations) Partial societal perspective: Moderate elimination was optimal (50% of simulations), followed by aggressive elimination (25% of simulations) Elimination (aggressive, moderate) strategies were preferred for over 1-year pandemic.	8

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
11	Broughel et al.2021[38, 39]†	USA	Suppression policies enforced by the U.S States. (Government suppression scenario)	Only targeted "mitigation" was practiced including case isolation, household quarantine, and social distancing among elderly and high-risk populations	Net mortality benefit (benefit from preventing COVID-19 death) = $320.7-$356.9 billion The net benefits of COVID-19 suppression policies relative to mitigation practices = $301-550.8 billion	NR	Suppression measures had positive net benefits ranging between $632.5 to $765.0 billion compared to mitigation practices from early March to August 1, 2020. Although suppression policies also resulted in substantial losses to GDP between $214-$332 billion, the net benefits of suppression policies on total economic production are positive and likely substantial.	9
12	Dutta et al. 2020[40]	India	National lockdown	Without lockdown	- Growth in income = 6% Net benefit of lockdown in India (Rs. Billion) = -9 340.81 or $ -424.78 billion (Loss in production = 5%); -17 759.42 or $ -807.63 billion (loss in production = 25%); -23 231.51 or $1056.48 billion (loss in production = 38%) - Growth in income = 7% Net benefit of lockdown in India (Rs. Billion) = -9 239.77 or $ -420.19 billion (loss in production = 5%); -17 658.38 or $ -803.03 billion (loss in production = 25%); -23 130.48 $ -105.32 billion (loss in production = 38%) - Growth in income = 8% Net benefit of lockdown in India (Rs. Billion) = -9 125.25 or $ -414.98 billion (loss in production = 5%); -17 543.86 or $ -797.83 billion (loss in production = 25%); -2315.96 or $-	NR	Net benefits are negative and vary from Rs (-)9,125.25 to (-) 23,231.5 billion ($ -414.98 to $ -1,051.88 million), depending upon the scenario. Even under heroic assumptions, therefore, ball point estimates do not justify the lockdown as costs of the lockdown exceed benefits; moreover, the result holds under all the scenarios considered.	7

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
					105.32 billion (loss in production = 38%)			
13	Gandjour, A. 2020[41]	Germany	Successful lockdown; ICU capacity exceeded by 50%, 100%, 200%, and 300%	No intervention	Flattening the curve: 1. Successful lockdown: value of life years gain (€) = 5691 (independence assumption) ($7633.38); 7,185 (harvesting assumption) ($9,637.30) 2. ICU capacity exceeded by 50%: value of life years gain (€) = 3518 (independence assumption) ($4,718.72); 4,386 (harvesting assumption) ($5,882.98) 3. ICU capacity exceeded by 100%: value of life years gain (€) = 1643 (independence assumption) ($2,203.77); 2022 (harvesting assumption) ($ 2,712.12) 4. ICU capacity exceeded by 200%: value of life years gain (€) = 525 (independence assumption) ($704.19); 629 (harvesting assumption) ($843.68) 5. ICU capacity exceeded by 300%: value of life years gain (€) = 129 (independence assumption) ($173.03); 159 (harvesting assumption) ($213.28) Squashing the curve 1. Successful lockdown: value of life years gain (€) = 48 160 (independence assumption)	€101,493 or $136,133 per life years gained	Shutdown that is successful in 'flattening the curve' is projected to yield an average health gain between 0.02 and 0.08 life years (0.2 to 0.9 months) per capita in the German population. The corresponding economic value ranges between €1543 ($US 2069.648) and €8027 ($US 10,766.68) per capita or, extrapolated to the total population, 4% to 19% of the gross domestic product (GDP) in 2019.	7

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
					($64,597); 45 411 (harvesting assumption) ($60,910.13)			
14	Khajji et al. 2020[42]	Morocco	Strategy 1: protecting susceptible individuals from contacting the infected individuals in the same region Strategy 2: protecting and preventing susceptible individuals from contacting the infected individuals in the same region or in other regions Strategy 3: protecting susceptible individuals, preventing their contact with the infected individuals, encouraging the exposed individuals to join quarantine centers Strategy 4: protecting susceptible individuals, preventing their contact with the infected individuals, encouraging the exposed individuals to join quarantine centers and the disposal of the infected animals	Strategy 3: protecting susceptible individuals, preventing their contact with the infected individuals, and encouraging the exposed individuals to join quarantine centers.	ICER Strategy 1: $0.1272/case averted ICER Strategy 2: $3.8926/case averted ICER Strategy 4: $0.1517/case averted	NR	Strategy 3 (protecting susceptible individuals, preventing their contact with the infected individuals, and encouraging the exposed individuals to join quarantine centers) is the most effective strategies.	5
15	Miles et al. 2021[43]	UK	Lockdown	Do nothing	The net extra economic costs of lockdown relative the easing restrictions are assumed to be £100 billion ($143 billion). <u>ICER of continuation of lockdown in relative to the easing</u>	£30000/QALY ($42,884) £20000/life saved ($28,589)	The costs of the lockdown exceed the benefits even on the most conservative estimates of £200 billion ($286 billion) or 0.9% of GDP resulting in the	7

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
					restrictions/QALY at 5 QALYs valued at £30,000) are as follows: ICER lockdown continuation vs. ease scenario I = $3.7 m ($5.23 m) ICER lockdown continuation vs. ease scenario II = $1.49 m ($2.13 m) ICER lockdown continuation vs. ease scenario III = $0.41 m ($0.58 m)	*Note:* benefits of lived saved include £20000/life saved for lower medical costs and the value of QALYs saved at £30000/QALY	total damage of £59 billion ($84 billion).	
16	Mol, B. and Karnon 2020[44]	Sweden and Denmark	Strict lockdown strategy (Denmark)	Flexible social distancing strategy (Sweden)	ICER = $137,285/LYS	$100,000 per life-year saved	In Sweden (Flexible social distancing strategy), COVID-19 mortality 577 or 6,350 LYs per million vs.111 or 1,216 LYs per million in Denmark (strict lockdown strategy) The incremental costs of strict lockdown to save one life year was $137,285, and higher in most of the sensitivity analyses.	8
17	Padula et al. 2020[45]	USA	1. Social distancing 2. Treatment 3. Vaccination	Do nothing	ICER social distancing= $-377,000 ICER treatment = $ -295,000 ICER vaccination = $-58,684.21	$50,000 per QALY	Social distancing, treatment or vaccination is preferred at a lower cost and higher effectiveness relative do nothing.	10
18	Reddy et al. 2021[46]	South Africa (KwaZulu-Natal)	Public health intervention strategies below: 1. HT+CT 2. HT+CT+IC 3. HT+CT+IC+MS 4. HT+CT+IC+QC 5. HT+CT+IC+MS+QC	Healthcare Testing (HT)	With Re 1.5, Compared with HT, HT+CT+IC+MS+QC was cost-effective (ICER $340/YLS), followed by HT+CT+IC+MS with ICER = $590/YLS With Re 1·2, HT+CT+IC+QC was cost saving.	ICER < $3250 per year-of life saved (YLS)	With Re 1.5, strategies involving HT+CT+IC+MS+QC was cost-effective (ICER $340/YLS) and reduced mortality by 94%. With low epidemic growth Re 1.1-1.2, HT+CT+IC+QC was the optimal strategy. The cost-effectiveness was sensitive to epidemic growth condition. With high epidemic	9

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
							growth (Re 2.6) that outpaced control measures, no combination of interventions was cost-effective compared with HT alone.	
19	Scherbina 2020[47]	USA	Suppression policy extended by 6, 10, 12, 15, 18-week	Suppression extended by 2-week (Lifting the lockdown after 2 weeks)	Under the pessimistic of the assumption policy's effectiveness R0=0.7, the lock down should be extended by another 18 weeks with the associated net benefit = $3.52 trillion. Under the optimistic of the assumption policy's effectiveness R0=0.5, the lock down should be extended by another 11 weeks with the associated net benefit = $3.81 trillion.	NR	The optimal duration of the lockdown ranges between 10 and 19 weeks. The optimal duration depends on its effectiveness in reducing the number of new infections. The lockdown should end before its incremental benefits falls below its incremental costs.	8
20	Schonberger et al. 2020[48]	USA	1. Full reopening and reduced social distancing 2. Shelter in place (SIP)	Limited reopening with social distancing	NR	$125,000 per QALY	A limited reopening to achieve partial mitigation of COVID-19 is cost-effective relative to a full reopening if an effective therapeutic or vaccine can be deployed within 11.1 months of late May 2020 (1.35 million lives or 9.1 million QALYs saved). Shelter-in-place restrictions are unlikely to demonstrate cost-effectiveness relative to a limited reopening strategy.	5
21	Sharma and Mishra 2020[49]	India	National lockdown	No lockdown	NR	NR	Overall, the nation-wide lockdown has helped India to save INR 2.74 trillion ($1.25 trillion) of the medical treatment costs on COVID-19 patients during the period of 25th March to 25th June 2020 which is equal to 1.86% of Indian GDP	4

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
22	Shlomai et al. 2020[50]	Israel	Non-selective nationwide lockdown	Focused isolation of individuals at high exposure risk	Nationwide lockdown is expected to save on average 274 (median 124, interquartile range (IQR): 71-221) lives compared to the "testing, tracing, and isolation" approach with ICER = $45,104,156 (median $ 49.6 million, IQR: 22.7-220.1) per death averted or $4.5m/QALY gained	$15,243-$17,366 per QALY	A national lockdown has a moderate advantage in saving lives with tremendous costs and possible overwhelming economic effects.	9
23	Thunstrom et al 2020[51]	USA	Social distancing policy	No social distancing policy	NMB = $5.16 trillion	$10 million/live saved (VSL)	The social distancing likely generates benefits with net benefits of $5.2 trillion.	8
24	Wang et al.2020[52]	China	**Single strategies:** 1. Personal protection 2. Isolation-and-quarantine 3. Gathering restriction 4. Community containment **Combination of public health measures:** 1. Personal protection (mask wearing and hand washing) and isolation-and-quarantine program (Program A) 2. Gathering restriction and isolation-and-quarantine, program (Program B) 3. Personal protection and community containment (Program C) 4. Personal protection, isolation-and-quarantine, and	No intervention	**ICER per human protected** Scenario I (imported one case): Single strategy Personal protection ICER = -$5,505 Isolation and quarantine ICER = -$6,788 Gathering and restriction ICER = $4,378 Community containment ICER = -$6,464 Joint strategy Program A ICER = -$6,690 Program B ICER = -$6,656 Program C ICER = -$6,396 Program D ICER = -$6,552 Scenario II (imported 4 cases): Single strategy Personal protection ICER = $1,278,438 Isolation and quarantine ICER = -$6,786 Gathering and restriction ICER = $378,709 Community containment ICER = -$6,483 Joint strategy Program A ICER = -$6,694 Program B ICER = -$6,665	ICER < 3 times of per capita GDP ($47,155.50)	Isolation-and-quarantine was the most cost-effective intervention. The joint strategy of personal protection and isolation-and-quarantine (Program A) was the optimal strategy in averting more infections compared to single strategy.	8

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
			gathering restriction (Program D)		Program C ICER = -$6,390 Program D ICER = -$6,571			
25	Xu et al 2020[53]	China	1. Epidemiological control including identification of infected cases, tracing their close contact tracing 2. Local social interaction control 3. Inter-city travel restriction	No restrictions	NR	NR	At early-stage scenario, the strictest control is the most cost-effectiveness measure. At accelerating stage, Peak stage: The strictest control is necessary to reverse the curve of the epidemic which results in heavy loss on economic output. At ending stage: loose control or lifting control would lead to cost-effectiveness when the controls are maintained through effective epidemiological control measures.	5
26	Zala et. al. 2020[54]	United Kingdom	1. Mitigation policy: individual case isolation, home quarantine, social distancing advice for people aged > 70 years old 2. Suppression 1: mitigation+social distancing+school closure, triggered "on" when there are 100 ICU cases/week, and "off" when weekly cases halve to 50 cases 3. Suppression 2: Suppression 1 triggered "on" when there are 400 ICU cases/week, and "off" when weekly cases halve to 200 cases	Unmitigated (Do nothing)	1. ICER Suppression 1 vs Unmitigated = £19,653 ($28,093.49) 2. ICER Suppression 1 vs Mitigated = £33,346 3. ICER Suppression 2 vs Unmitigated = £20,977 ($29986.31) 4. ICER Suppression 2 vs mitigated = £38,314 5. ICER Mitigated vs Unmitigated = £6,766 ($9,671.87)	£20,000-30,000 per QALY ($28,589-42,884)	Assuming more conservative national income loss scenarios (10% under suppression), ICERs for the Imperial model–projected suppression policy versus an unmitigated pandemic are below £50,000 per QALY (NICE WTP). Therefore, it is difficult to claim that suppression policies are obviously cost-ineffective.	8

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
27	Zhao et al 2021[55]	China	Strategy B: 1 week delay movement restriction Strategy C: 2 weeks delay movement restriction Strategy D: 4 weeks delay movement restriction	Strategy A: Rapid implementation of movement restriction	Incremental societal cost strategy B = RMB 1920 billion ($458.72); Incremental societal cost strategy C = RMB 3682 billion ($879.68); Incremental societal cost strategy D = RMB 20327 billion ($4,856)	70,892 RMB per disability-adjusted life-year saved ($16,937)	Strategy A dominates all other strategies, from both a healthcare perspective and societal perspective.	10
Protection								
28	Bagepally et al. 2021[56]	India	1. Surgical mask 2. N-95 respirator (fit tested) 3. N-95 respirator (non-fit tested) 4. Hand hygiene 5. Surgical mask + hand hygiene	Do nothing	ICER per QALY vs. no intervention 1. ICER surgical mask = 78.49 million INR ($3.57 million) 2. N-95 respirator (fit-tested) = 431.24 million INR ($19.61 million) 3. N-95 respirator (non-fit tested) = 227.28 million INR ($10.34 million) 4. Hand hygiene = 8.30 million INR ($0.38 million) 5. Surgical mask + hand hygiene = 85.65 million INR ($3.90 million)	Indian's GDP per capita of INR 142,719 per QALY gained ($6,671.77)	None of these interventions were cost-effective, considering the WHO based willingness to pay threshold. Hand hygiene appeared to be less expensive as compared to other interventions	9
29	Ebigbo et al. 2021[57]	Germany	Strategy 2: No routine pre-endoscopy virus test; additional use of FFP-2 and water-resistant gowns for all procedures Strategy 3: Decentralized point of care antigen test; use of surgical masks, goggles, gloves and apron for all procedures Strategy 4: Decentralized point of care antigen test; additional use of FFP-2 and water-resistant gowns for all procedures irrespective of test result.	Strategy 1. No routine pre-endoscopy virus test; use of surgical masks, goggles, gloves and apron for all procedures	<u>Prevalence = 0.01% (Laplace), ICER per number of patients who tested positive</u> ICER Strategy 3 = 259,866€ ($348,560.31) ICER Strategy 4 = 419,121€ ($562,170.29) ICER Strategy 5 = 1,597,820€ ($2,143,168.52) ICER Strategy 6 = 1,700,059€ ($2,280,302.49) ICER Strategy 7 = 2,632,347€ ($3,530,787.71) ICER Strategy 8= 2,735,256€ ($3,668,820.36) <u>Prevalence = 0.1% (Laplace), ICER per number of patients who tested positive</u> ICER Strategy 3 = 11,774€	NR	For low prevalence situations (0.01% and 0.1%), the ICER values were lowest when a strategy of POC antigen testing without the routine use of high-risk PPE for all patients was implemented (Strategy 3). However, for higher prevalence rates of 1% and 5%, the lowest ICER values were achieved with rapid POC antigen testing coupled with high-risk PPE use for all patients (Strategy 4).	7

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
			Strategy 5: Centralized laboratory-based rapid PCR test; use of surgical masks, goggles, gloves and apron for all procedures Strategy 6: Centralized laboratory-based rapid PCR test; additional use of FFP-2 and water-resistant gowns for all procedures irrespective of test result. Strategy 7: Centralized laboratory-based standard PCR test; use of surgical masks, goggles, gloves and apron for all procedures Strategy 8: Centralized laboratory-based standard PCR test; additional use of FFP-2 and water-resistant gowns for all procedures irrespective of test result.		($15,792.56) ICER Strategy 4 = 17,451€ ($23,407.16) ICER Strategy 5 = 145,570€ ($195,254.18) ICER Strategy 6 = 155,150€ ($208,103.91) ICER Strategy 7 = 249,022€ ($33,4015.16) ICER Strategy 8= 258,557€ ($346,804.53) <u>Prevalence = 1%, ICER per number of patients who tested positive</u> ICER Strategy 3 = -13,035€ ($ -17,483.95) ICER Strategy 4 = -22,716€ ($ -30,469.15) ICER Strategy 5 = 345€ ($462.75) ICER Strategy 6 = 659€ ($ 883.92) ICER Strategy 7 = 10,690€ ($14,338.58) ICER Strategy 8= 10,887€ ($14,602.82) <u>Prevalence = 5%, ICER per number of patients who tested positive</u> ICER Strategy 3 = -15,240€ ($ -20,441.53) ICER Strategy 4 = -26,286€ ($-35,257.61) ICER Strategy 5 = -12,564€ ($ -16,852.19) ICER Strategy 6 = -13,073€ ($ -17,534.92) ICER Strategy 7 = -10,495€ ($ -14,077.03) ICER Strategy 8 = -11,128€ ($ -14,926.07)			

No	Author, Year	Country	Interventions	Comparison	ICER/NMB	WTP threshold	Main findings	Drummond score 0-10
30	Risko et. al. 2020[58]	LMICs	Full personal protective equipment (PPE) supply per the WHO best practice guidelines to maintain a low rate of HCW infection	Inadequate PPE with absence of one or more PPE elements	Mean ICER Full PPE= $4,309/HCW life saved Mean ICER Full PPE = $59/HCW case averted	NR	An investment of $9.6 billion would adequately protect HCWs in all LMICs. This intervention would save 2,299,543 lives across LMICs, costing $59 per HCW case averted and $4,309 per HCW life saved.	9
31	Savitsky et al. 2020[59]	USA	Universal Screening	Universal PPE	NR	$25,000/HCW case averted	In the base case assuming a COVID-19 prevalence of 0.36%, universal PPE is cost saving for a planned CD while for spontaneous and induced labor, a cost to prevent transmission to one HCW are $4,175,229 and $3,413,251 respectively making universal screening was preferred. At high prevalence of 34.27% to 29.54%, universal PPE is cost-effective for spontaneous and induced labor.	9

ACS, Alternative care site; CD, caesarean delivery; CDC, the Centers for Disease Control and Prevention; CT, Contact Tracing; DALY, Disability adjusted life years; DesigIsol, Designated isolation in separate location for student quarantine; HCW, healthcare worker, HT, Healthcare Testing; IC, Isolation Center; ICER, Incremental cost-effectiveness ratio; LMICs, Low-middle income countries; LT, Laboratory testing; MS, Mass Symptom Screening; NA, Not applied; NMB, Net monetary benefit; NR, Not reported; PPE, personal protective equipment; QALY, Quality adjusted life years; QC, Quarantine Centers; RLTqX, routine LT every X days; ResIsol, Residence isolation in student dorm room; RMB, The Renminbi or Chinese Yuan (¥); SALIRD, Susceptible-asymptomatic-pre-symptomatic-symptomatic-recovered-deceased; SEIR, Susceptible-Exposed-Infected-Recovered; USA, The United States of America; VSL, Value of Statistical Life; WTP, Willingness to pay; YLL, years of life lost; YLS, years of life saved; *Not reported by the authors but interpreted from methodology and key findings; †The most recent publication was cited.

Appendix 5 Summary of rating using the 10-item Drummond's checklist

No	Author, Year	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Screening/detection											
1	Atkeson et al 2021[27]	+	+	?	?	+	+	−	+	+	−
2	Baggett et al. 2020[29]	+	+	+	+	+	+	−	+	+	+
3	Du et al. 2021[30]	+	+	−	+	+	+	−	+	+	+
4	Jiang et al. 2020[31]	+	+	−	?	+	+	+	+	+	+
5	Losina et al. 2020[32]	+	+	+	+	+	+	−	+	+	+
6	Neilan et al. 2020[33]	+	+	+	?	+	+	+	+	+	+
7	Paltiel et al.2020[34]	+	+	−	+	+	+	−	+	+	+
8	Zafari et al. 2020[35]	+	+	+	+	+	+	−	+	+	+
Suppression/containment											
9	Asamoah et al. 2020[36]	+	+	+	−	−	−	−	+	−	−
10	Blakely et al. 2021[37]	+	+	+	+	−	+	+	−	+	+
11	Broughel et al. 2021[38, 39]†	+	+	+	+	+	+	+	+	+	−
12	Dutta et al. 2020[40]	+	+	+	-	+	+	+	−	+	−
13	Gandjour 2020[41]	+	+	−	?	+	+	−	+	+	+
14	Khajji et al. 2020[42]	+	+	−	?	+	+	−	+	−	−
15	Miles et al. 2021[43]	+	+	+	-	+	+	−	+	+	−
16	Mol and Karnon 2020[44]	+	+	+	+	−	+	−	+	+	+
17	Padula et al. 2020[45]	+	+	+	+	+	+	+	+	+	+
18	Reddy et al. 2021[46]	+	+	+	+	+	+	−	+	+	+
19	Scherbina et. al. 2020[47]	+	+	-	+	+	+	−	+	+	+
20	Schonberger et al. 2020[48]	+	+	?	?	+	?	+	+	−	−
21	Sharma and Mishra 2020[49]	+	+	?	?	+	+	−	−	−	−
22	Shlomai et al. 2020[50]	+	+	+	+	+	+	−	+	+	+
23	Thunstrom et al 2020[51]	+	+	+	?	+	+	+	−	+	+

No	Author, Year	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
24	Wang et al.2020[52]	+	+	–	+	+	+	–	+	+	+
25	Xu et al. 2020[53]	+	+	–	–	+	–	–	–	+	+
26	Zala et. al. 2020[54]	+	+	-	+	+	+	–	+	+	+
27	Zhao et al 2021[55]	+	+	+	+	+	+	+	+	+	+
Protection											
28	Bagepally et al. 2021[56]	+	+	+	+	+	+	–	+	+	+
29	Ebigbo et al. 2021[57]	+	+	–	?	+	+	–	+	+	+
30	Risko et. al. 2020[58]	+	+	+	+	+	+	–	+	+	+
31	Savitsky et al. 2020[59]	+	+	+	+	+	+	–	+	+	+

+ Yes

? Probably Yes

\- Possibliy Yes

– No

10-item Drummond's Checklist

1 Was a well-defined question posed in answerable form?

2 Was a comprehensive description of the competing alternatives given?

3 Was the effectiveness of the programs or services established?

4 Were all the important and relevant costs and consequences for each alternative identified?

5 Were costs and consequences measured accurately in appropriate physical units?

6 Were costs and consequences value credibly?

7 Were costs and consequences adjusted for differential timing (discounting)?

8 Was an incremental analysis of costs and consequences of alternatives performed?

9 Was allowance made for uncertainty in the estimates of costs and consequences?

10 Did the presentation and discussion of study results include all issues of concern to users?

References

1. Bhutta ZA, Harari O, Park JJH, Zannat N, Zoratti M, Churches T, et al. Evaluation of effects of public health interventions on COVID-19 transmission for Pakistan: A mathematical simulation study. medRxiv. 2020:2020.04.30.20086447. doi: 10.1101/2020.04.30.20086447.
2. Childs ML, Kain MP, Kirk D, Harris M, Couper L, Nova N, et al. The impact of long-term non-pharmaceutical interventions on COVID-19 epidemic dynamics and control. medRxiv. 2020:2020.05.03.20089078. doi: 10.1101/2020.05.03.20089078.
3. Chowdhury R, Heng K, Shawon MSR, Goh G, Okonofua D, Ochoa-Rosales C, et al. Dynamic interventions to control COVID-19 pandemic: a multivariate prediction modelling study comparing 16 worldwide countries. European journal of epidemiology. 2020;35(5):389-99. Epub 2020/05/21. doi: 10.1007/s10654-020-00649-w. PubMed PMID: 32430840; PubMed Central PMCID: PMCPMC7237242.
4. Courtemanche C, Garuccio J, Le A, Pinkston J, Yelowitz A. Strong Social Distancing Measures In The United States Reduced The COVID-19 Growth Rate. Health affairs (Project Hope). 2020;39(7):1237-46. Epub 2020/05/15. doi: 10.1377/hlthaff.2020.00608. PubMed PMID: 32407171.
5. Das A, Dhar A, Kundu A, Goyal S. Covid-19: analysis of a modified SEIR model, a comparison of different intervention strategies and projections for India. medRxiv. 2020:2020.06.04.20122580. doi: 10.1101/2020.06.04.20122580.
6. de Oliveira CA. A Preliminary Estimation of the Economic Costs of Lockdown in Rio Grande do Sul. Revista Do Servico Publico. 2020;71:22-41. doi: 10.21874/rsp.v71i0.4830. PubMed PMID: WOS:000592222800003.
7. Di Domenico L, Pullano G, Sabbatini CE, Boëlle P-Y, Colizza V. Impact of lockdown on COVID-19 epidemic in Île-de-France and possible exit strategies. BMC medicine. 2020;18(1):1-13. doi: 10.1186/s12916-020-01698-4. PubMed PMID: 144825076. Language: English. Entry Date: In Process. Revision Date: 20200925. Publication Type: journal article.
8. Erandi KKWH, Mahasinghe AC, Perera SSN, Jayasinghe S. Effectiveness of the strategies implemented in Sri Lanka for controlling the COVID–19 outbreak. medRxiv. 2020:2020.04.27.20082479. doi: 10.1101/2020.04.27.20082479.
9. Glass DH. European lockdowns and the consequences of relaxation during the COVID-19 pandemic. medRxiv. 2020:2020.05.19.20106542. doi: 10.1101/2020.05.19.20106542.
10. Hernandez A, Correa-Agudelo E, Kim H, Branscum AJ, Miller FD, MacKinnon N, et al. On the impact of early non-pharmaceutical interventions as containment strategies against the COVID-19 pandemic. medRxiv. 2020:2020.05.05.20092304. doi: 10.1101/2020.05.05.20092304.
11. Hyafil A, Moriña D. Analysis of the impact of lockdown on the reproduction number of the SARS-Cov-2 in Spain. medRxiv. 2020:2020.04.18.20070862. doi: 10.1101/2020.04.18.20070862.
12. Jardim L, Diniz-Filho JA, Rangel TF, Toscano CM. The effective reproductive number (Rt) of COVID-19 and its relationship with social distancing. medRxiv. 2020:2020.07.28.20163493. doi: 10.1101/2020.07.28.20163493.
13. Kadyrov S, Orynbassar A, Saydaliyev HB, Yergesh D. Mathematical Modelling the Impact Evaluation of Lockdown on Infection Dynamics of COVID-19 in Italy. medRxiv. 2020:2020.07.27.20162537. doi: 10.1101/2020.07.27.20162537.
14. Kohanovski I, Obolski U, Ram Y. Inferring the effective start dates of non-pharmaceutical interventions during COVID-19 outbreaks. medRxiv. 2020:2020.05.24.20092817. doi: 10.1101/2020.05.24.20092817.
15. Lemaitre JC, Perez-Saez J, Azman A, Rinaldo A, Fellay J. Assessing the impact of non-pharmaceutical interventions on SARS-CoV-2 transmission in Switzerland. medRxiv. 2020:2020.05.04.20090639. doi: 10.1101/2020.05.04.20090639.
16. Min KD, Kang H, Lee JY, Jeon S, Cho SI. Estimating the Effectiveness of Non-Pharmaceutical Interventions on COVID-19 Control in Korea. Journal of Korean medical science. 2020;35(35):e321. Epub 2020/09/08. doi: 10.3346/jkms.2020.35.e321. PubMed PMID: 32893522; PubMed Central PMCID: PMCPMC7476801.
17. Nannyonga BK, Wanyenze RK, Kaleebu P, Ssenkusu JM, Lutalo T, Makumbi FE, et al. Estimating the Effect and Cost-Effectiveness of Facemasks in Reducing the Spread of the Severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV-2) in Uganda. medRxiv. 2020:2020.06.11.20128272. doi: 10.1101/2020.06.11.20128272.
18. Ricoca Peixoto V, Vieira A, Aguiar P, Carvalho C, Thomas D, Abrantes A. Rapid assessment of the impact of lockdown on the COVID-19 epidemic in Portugal. medRxiv. 2020:2020.05.26.20098244. doi: 10.1101/2020.05.26.20098244.

19. VoPham T, Weaver MD, Hart JE, Ton M, White E, Newcomb PA. Effect of social distancing on COVID-19 incidence and mortality in the US. medRxiv. 2020:2020.06.10.20127589. doi: 10.1101/2020.06.10.20127589.
20. Mulligan CB. Economic activity and the value of medical innovation during a pandemic. Becker-Friedman Institute Working Paper 2020-48 [Internet]. 2020 April [cited 2021 15 November]; (April). Available from: https://www.nber.org/papers/w27060.
21. Piovani D, Christodoulou MN, Hadjidemetriou A, Pantavou K, Zaza P, Bagos PG, et al. Effect of early application of social distancing interventions on COVID-19 mortality over the first pandemic wave: An analysis of longitudinal data from 37 countries. The Journal of infection. 2021;82(1):133-42. Epub 2020/12/05. doi: 10.1016/j.jinf.2020.11.033. PubMed PMID: 33275956; PubMed Central PMCID: PMCPMC7706420.
22. Gandjour A. How much reserve capacity is justifiable for hospital pandemic preparedness? A cost-effectiveness analysis for COVID-19 in Germany. medRxiv. 2020:2020.07.27.20162743. doi: 10.1101/2020.07.27.20162743.
23. Jiang X, Yao J, You JH. Cost-effectiveness of a Telemonitoring Program for Patients With Heart Failure During the COVID-19 Pandemic in Hong Kong: Model Development and Data Analysis. Journal of medical Internet research. 2021;23(3):e26516. Epub 2021/03/04. doi: 10.2196/26516. PubMed PMID: 33656440; PubMed Central PMCID: PMCPMC7931824.
24. Shaker MS, Mosnaim G, Oppenheimer J, Stukus D, Abrams EM, Greenhawt M. Health and Economic Outcomes of Home Maintenance Allergen Immunotherapy in Select Patients with High Health Literacy during the COVID-19 Pandemic: A Cost-Effectiveness Analysis During Exceptional Times. The journal of allergy and clinical immunology In practice. 2020;8(7):2310-21.e4. Epub 2020/05/18. doi: 10.1016/j.jaip.2020.05.007. PubMed PMID: 32417446; PubMed Central PMCID: PMCPMC7224677.
25. Sriwijitalai W, Wiwanitkit V. International Journal of Preventive Medicine. 2020;11(1).
26. Gandhi M, Rutherford GW. Facial Masking for Covid-19 — Potential for "Variolation" as We Await a Vaccine. New England Journal of Medicine. 2020;383(18):e101. doi: 10.1056/NEJMp2026913.
27. Atkeson A, Droste M, Mina MJ, Stock JH. Economic Benefits of COVID-19 Screening Tests with a Vaccine Rollout. medRxiv. 2021:2021.03.03.21252815. doi: 10.1101/2021.03.03.21252815.
28. Miles D, Stedman M, Heald A. LIVING WITH COVID-19: BALANCING COSTS AGAINST BENEFITS IN THE FACE OF THE VIRUS. National Institute Economic Review. 2020;253:R60-R76. doi: 10.1017/nie.2020.30. PubMed PMID: WOS:000553044300009.
29. Baggett TP, Scott JA, Le MH, Shebl FM, Panella C, Losina E, et al. Clinical Outcomes, Costs, and Cost-effectiveness of Strategies for Adults Experiencing Sheltered Homelessness During the COVID-19 Pandemic. JAMA Netw Open. 2020;3(12):e2028195. Epub 2020/12/23. doi: 10.1001/jamanetworkopen.2020.28195. PubMed PMID: 33351082; PubMed Central PMCID: PMCPMC7756240
30. Du Z, Pandey A, Bai Y, Fitzpatrick MC, Chinazzi M, Pastore YPA, et al. Comparative cost-effectiveness of SARS-CoV-2 testing strategies in the USA: a modelling study. The Lancet Public health. 2021;6(3):e184-e91. Epub 2021/02/08. doi: 10.1016/s2468-2667(21)00002-5. PubMed PMID: 33549196; PubMed Central PMCID: PMCPMC7862022.
31. Jiang Y, Cai D, Chen D, Jiang S. The cost-effectiveness of conducting three versus two reverse transcription-polymerase chain reaction tests for diagnosing and discharging people with COVID-19: evidence from the epidemic in Wuhan, China. BMJ global health. 2020;5(7). Epub 2020/07/23. doi: 10.1136/bmjgh-2020-002690. PubMed PMID: 32694221; PubMed Central PMCID: PMCPMC7385750.
32. Losina E, Leifer V, Millham L, Panella C, Hyle EP, Mohareb AM, et al. College Campuses and COVID-19 Mitigation: Clinical and Economic Value. Annals of internal medicine. 2020;21.
33. Neilan AM, Losina E, Bangs AC, Flanagan C, Panella C, Eskibozkurt GE, et al. Clinical Impact, Costs, and Cost-Effectiveness of Expanded SARS-CoV-2 Testing in Massachusetts. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America. 2020;18.
34. Paltiel AD, Zheng A, Walensky RP. Assessment of SARS-CoV-2 Screening Strategies to Permit the Safe Reopening of College Campuses in the United States. JAMA Network Open. 2020;3(7):e2016818-e. doi: 10.1001/jamanetworkopen.2020.16818.
35. Zafari Z, Korvizhkin K, Goldman L, Muennig P. The cost-effectiveness of common strategies for the prevention of transmission of SARS-CoV-2 in universities. medRxiv. 2020:2020.08.13.20166975. doi: 10.1101/2020.08.13.20166975.
36. Asamoah JKK, Owusu MA, Jin Z, Oduro FT, Abidemi A, Gyasi EO. Global stability and cost-effectiveness analysis of COVID-19 considering the impact of the environment: using data from Ghana. Chaos, Solitons & Fractals. 2020;140:110103. doi: https://doi.org/10.1016/j.chaos.2020.110103.

37. Blakely T, Thompson J, Bablani L, Andersen P, Ouakrim DA, Carvalho N, et al. Determining the optimal COVID-19 policy response using agent-based modelling linked to health and cost modelling: Case study for Victoria, Australia. medRxiv. 2021:2021.01.11.21249630. doi: 10.1101/2021.01.11.21249630.
38. Broughel J, Kotrous M. The Benefits of Coronavirus Suppression: A Cost-Benefit Analysis of the Response to the First Wave of COVID-19 in the United States. Covid Economics 67 [Internet]. 2021 February 4, 2021:[128-71 pp.]. Available from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3783563 or http://dx.doi.org/10.2139/ssrn.3783563.
39. Broughel J, Kotrous M. The benefits of coronavirus suppression: A cost-benefit analysis of the response to the first wave of COVID-19 in the United States. PLOS ONE. 2021;16(6):e0252729. doi: 10.1371/journal.pone.0252729.
40. Dutta M, Husain Z. What cost decisiveness? A cost benefit analysis of the lockdown to contain COVID-19 in India. medRxiv. 2020:2020.07.07.20148338. doi: 10.1101/2020.07.07.20148338.
41. Gandjour A. The Clinical and Economic Value of a Successful Shutdown During the SARS-CoV-2 Pandemic in Germany. medRxiv. 2020:2020.05.12.20098996. doi: 10.1101/2020.05.12.20098996.
42. Khajji B, Kada D, Balatif O, Rachik M. A multi-region discrete time mathematical modeling of the dynamics of Covid-19 virus propagation using optimal control. J Appl Math Comput. 2020:1-27. Epub 2020/05/12. doi: 10.1007/s12190-020-01354-3. PubMed PMID: 32390786; PubMed Central PMCID: PMCPMC7205920.
43. Miles DK, Stedman M, Heald AH. "Stay at Home, Protect the National Health Service, Save Lives": A cost benefit analysis of the lockdown in the United Kingdom. International Journal of Clinical Practice. 2021;75(3).
44. Mol BW, Karnon J. Strict lockdown versus flexible social distance strategy for COVID-19 disease: a cost-effectiveness analysis. medRxiv. 2020:2020.09.14.20194605. doi: 10.1101/2020.09.14.20194605.
45. Padula WV, Malaviya S, Reid NM, Tierce J, Alexander GC. Economic Value of Treatment and Vaccine to Address the COVID-19 Pandemic: A U.S. Cost-Effectiveness and Budget Impact Analysis. SSRN [Internet]. 2020 22 April 2020. Available from: https://ssrn.com/abstract=3586694 or http://dx.doi.org/10.2139/ssrn.3586694.
46. Reddy KP, Shebl FM, Foote JHA, Harling G, Scott JA, Panella C, et al. Cost-effectiveness of public health strategies for COVID-19 epidemic control in South Africa: a microsimulation modelling study. The Lancet Global health. 2021;9(2):e120-e9. Epub 2020/11/15. doi: 10.1016/s2214-109x(20)30452-6. PubMed PMID: 33188729; PubMed Central PMCID: PMCPMC7834260.
47. Scherbina A. Determining the optimal duration of the COVID-19 suppression policy: A cost-benefit analysis. American Enterprise Institute, 2020.
48. Schonberger RB, Listokin YJ, Ayres I, Yaesoubi R, Shelley ZR. Cost Benefit Analysis of Limited Reopening Relative to a Herd Immunity Strategy or Shelter in Place for SARS-CoV-2 in the United States. medRxiv. 2020:2020.06.26.20141044. doi: 10.1101/2020.06.26.20141044.
49. Sharma N, Mishra P. Cost Benefit Analysis of COVID-19 Lockdown in India. Int J Innovat Med Health Sci. 2020;12(Special Issue):34-40.
50. Shlomai A, Leshno A, Sklan EH, Leshno M. Modeling social distancing strategies to prevent SARS-CoV2 spread in Israel- A Cost-effectiveness analysis. medRxiv. 2020:2020.03.30.20047860. doi: 10.1101/2020.03.30.20047860.
51. Thunstrom L, Newbold SC, Finnoff D, Ashworth M, Shogren JF. The Benefits and Costs of Using Social Distancing to Flatten the Curve for COVID-19. Journal of Benefit-Cost Analysis. 2020;11(2):179-95. doi: 10.1017/bca.2020.12. PubMed PMID: WOS:000559400200002.
52. Wang Q, Shi N, Huang J, Cui T, Yang L, Ai J, et al. Effectiveness and cost-effectiveness of public health measures to control COVID-19: a modelling study. medRxiv. 2020:2020.03.20.20039644. doi: 10.1101/2020.03.20.20039644.
53. Xu L, Zhang H, Deng Y, Wang K, Li F, Lu Q-G, et al. Cost-effectiveness Analysis of Antiepidemic Policies and Global Situation Assessment of COVID-19. arXiv: Physics and Society. 2020.
54. Zala D, Mosweu I, Critchlow S, Romeo R, McCrone P. Costing the COVID-19 Pandemic: An Exploratory Economic Evaluation of Hypothetical Suppression Policy in the United Kingdom. Value Health. 2020;23(11):1432-7. Epub 2020/11/01. doi: 10.1016/j.jval.2020.07.001. PubMed PMID: 33127013.
55. Zhao J, Jin H, Li X, Jia J, Zhang C, Zhao H, et al. Disease Burden Attributable to the First Wave of COVID-19 in China and the Effect of Timing on the Cost-Effectiveness of Movement Restriction Policies. Value in Health. 2021.
56. Bagepally BS, Haridoss M, Natarajan M, Jeyashree K, Ponnaiah M. Cost-effectiveness of surgical mask, N-95 respirator, hand-hygiene and surgical mask with hand hygiene in the prevention of COVID-19: Cost effectiveness analysis from Indian context. Clinical Epidemiology and Global Health. 2021;10 (no pagination).
57. Ebigbo A, Römmele C, Bartenschlager C, Temizel S, Kling E, Brunner J, et al. Cost-effectiveness analysis of SARS-CoV-2 infection prevention strategies including pre-endoscopic virus testing and use of high risk personal

protective equipment. Endoscopy. 2021;53(2):156-61. Epub 2020/10/21. doi: 10.1055/a-1294-0427. PubMed PMID: 33080647; PubMed Central PMCID: PMCPMC7869042.
58. Risko N, Werner K, Offorjebe OA, Vecino-Ortiz AI, Wallis LA, Razzak J. Cost-effectiveness and return on investment of protecting health workers in low- and middle-income countries during the COVID-19 pandemic. PLoS One. 2020;15(10):e0240503. Epub 2020/10/10. doi: 10.1371/journal.pone.0240503. PubMed PMID: 33035244; PubMed Central PMCID: PMCPMC7546502.
59. Savitsky LM, Albright CM. Preventing COVID-19 Transmission on Labor and Delivery: A Decision Analysis. American journal of perinatology. 2020;37(10):1031-7. Epub 2020/06/17. doi: 10.1055/s-0040-1713647. PubMed PMID: 32544961; PubMed Central PMCID: PMCPMC7416191.