

**Supplement to: Tang X, Sun S, Memedi M, Hiyoshi A, Montgomery S, Cao Y.
Cost-effectiveness of preventive COVID-19 interventions: a systematic review
and network meta-analysis of comparative economic evaluation studies based on
real-world data. J Glob Health. 2025;15:04017.**



Documentation of search strategies University Library search consultation group

Date: March 14, 2024

Topic/research question: Costs (including direct medical costs and productivity loss) and effectiveness associated with different anti-pandemic strategies/interventions?

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Databases:

1. Medline (Ovid)
 2. Cochrane Library (Wiley)
 3. Embase (embase.com)
 4. Web of Science Core Collection (Clarivate)
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Total number of hits:

- Before deduplication: 9 652 (8 127 July 2023)
 - After deduplication: 6 161 (5178 [July 2023] + 983 [March 2024])
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Search strategy

A literature search was performed in the following databases: Medline (Ovid), Cochrane Library (Wiley), Embase (embase.com) and Web of Science Core Collection (Clarivate). The last search was conducted 2024-03-14.

After the original search was performed on 4 July 2023, the search was last updated on 14 March 2024 using the methods described by Bramer et al. (1)

The search strategy was developed in Medline (Ovid) in collaboration with librarians at the Karolinska Institutet University Library. For each search concept Medical Subject Headings (MeSH-terms) and free text terms were identified. The search was then translated, in part using Polyglot Search Translator (2), into the other databases.

Language restriction was made to English.

Articles from before the pandemic (e.g. older than 2019) were not reviewed.

De-duplication was done using the method described by Bramer et al (3). One final, extra step was added to compare DOIs.

References

1. Bramer W, Bain P. (2017). Updating search strategies for systematic reviews using EndNote. *Journal of the Medical Library Association: JMLA*, 105(3):285-289. doi: 10.5195/jmla.2017.183.
2. Clark JM, Sanders S, Carter M, Honeyman D, Cleo G, Auld Y, Booth D, Condron P, Dalais C, Bateup S, Linthwaite B, May N, Munn J, Ramsay L, Rickett K, Rutter C, Smith A, Sondergeld P, Wallin M, Jones M, Beller E. (2020) Improving the translation of search strategies using the Polyglot Search Translator: a randomized controlled trial. *Journal of the Medical Library Association: JMLA*. 108(2):195-207. doi: 10.5195/jmla.2020.834.
3. Bramer, W. M., Giustini, D., de Jonge, G. B., Holland, L., & Bekhuis, T. (2016). De-duplication of database search results for systematic reviews in EndNote. *Journal of the Medical Library Association: JMLA*, 104(3), 240-243. doi: 10.3163/1536-5050.104.3.014

1. Medline

Interface: Ovid MEDLINE(R) ALL

Date of Search: 14 March 2024

Number of hits: 2 398

Comment: In Ovid, two or more words are automatically searched as phrases; i.e. no quotation marks are needed

Field labels

- exp/ = exploded MeSH term
- / = non exploded MeSH term
- .ti,ab,kf. = title, abstract and author keywords
- adjx = within x words, regardless of order
- * = truncation of word for alternate endings

Database(s): Ovid MEDLINE(R) ALL 1946 to March 13, 2024

Search Strategy:

#	Searches	Results
1	COVID-19/	257196
2	exp COVID-19 Testing/	12295
3	COVID-19 Vaccines/	24034
4	SARS-CoV-2/	165903
5	(Coronavirus/ or Betacoronavirus/ or Coronavirus infections/) and (Disease outbreaks/ or Epidemics/ or Pandemics/)	40280
6	(nCov* or 2019nCoV or 19nCoV or COVID* or SARS-COV-2 or SARSCOV-2 or SARS-COV2 or SARSCOV2 or SARS coronavirus 2 or Severe Acute Respiratory Syndrome Coronavirus 2 or Severe Acute Respiratory Syndrome Corona Virus 2).ti,ab,kf,nm,ox,rx,px.	402076
7	((coronavirus* or corona virus* or betacoronavirus*) and (pandemic* or epidemic* or outbreak* or crisis)).ti,ab,kf.	78954
8	((Wuhan or Hubei) adj5 pneumonia).ti,ab,kf.	427
9	((new or novel or "19" or "2019" or Wuhan or Hubei or China or Chinese) adj3 (coronavirus* or corona virus* or betacoronavirus* or CoV or HCoV)).ti,ab,kf.	100377
10	or/1-9	418067
11	Cost-Effectiveness Analysis/	786
12	Cost-Benefit Analysis/	94203
13	((cost? adj3 (benefit* or effect* or utilit* or minimi* or consequence*)) and analy*).ti,ab,kf.	100124
14	(economic adj3 evaluat*).ti,ab,kf.	19932
15	(cost-benefit* or cost-effectiveness* or cost-utility* or cost-minimi#ation* or cost-consequence*).ti,ab,kf.	95594
16	11 or 12 or 13 or 14 or 15	191149
17	10 and 16	2459
18	limit 17 to (english language and yr="2019 -Current")	2398

2. Embase

Interface: embase.com		Field labels <ul style="list-style-type: none">/exp = exploded Emtree term/de = non exploded Emtree termti,ab,kw = title, abstract and author keywordsNEAR/x = within x words, regardless of order* = truncation of word for alternate endings
Date of Search: 14 March 2024		
Number of hits: 4 079		
Comment: Emtree is the controlled vocabulary in Embase		

#	Searches	Results
#01	'coronavirus disease 2019'/exp	387373
#02	'covid-19 testing'/exp	11114
#03	'sars-cov-2 vaccine'/de	31732
#04	'severe acute respiratory syndrome coronavirus 2'/exp	110346
#05	('coronavirinae'/de OR 'betacoronavirus'/de OR 'coronavirus infection'/de) AND ('epidemic'/exp OR 'pandemic'/de)	11208
#06	ncov*:ti,ab,kw OR 2019ncov:ti,ab,kw OR 19ncov:ti,ab,kw OR covid*:ti,ab,kw OR 'sars cov 2':ti,ab,kw OR 'sarscov 2':ti,ab,kw OR 'sars cov2':ti,ab,kw OR sarscov2:ti,ab,kw OR 'sars coronavirus 2':ti,ab,kw OR 'severe acute respiratory syndrome coronavirus 2':ti,ab,kw OR 'severe acute respiratory syndrome corona virus 2':ti,ab,kw	456446
#07	(coronavirus*:ti,ab,kw OR 'corona virus':ti,ab,kw OR betacoronavirus*:ti,ab,kw) AND (pandemic*:ti,ab,kw OR epidemic*:ti,ab,kw OR outbreak*:ti,ab,kw OR crisis:ti,ab,kw)	79831
#08	((wuhan OR hubei) NEAR/5 pneumonia):ti,ab,kw	523
#09	((new OR novel OR 19 OR 2019 OR wuhan OR hubei OR china OR chinese) NEAR/3 (coronavirus* OR 'corona virus*' OR betacoronavirus* OR cov OR hcov)):ti,ab,kw	104418
#10	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9	502646
#11	'economic evaluation'/exp	364127
#12	((cost\$ NEAR/3 (benefit* OR effect* OR utilit* OR minimi* OR consequence*)):ti,ab,kw) AND analy*:ti,ab,kw AND ((economic NEAR/3 evaluat*):ti,ab,kw)	12924
#13	'cost benefit':ti,ab,kw OR 'cost effectiveness':ti,ab,kw OR 'cost utility':ti,ab,kw OR 'cost minimi?ation':ti,ab,kw OR 'cost consequence':ti,ab,kw	137915
#14	(economic NEAR/3 evaluat*):ti,ab,kw	28285
#15	#11 OR #12 OR #13 OR #14	397206
#16	#10 AND #15	5382
#17	#10 AND #15 AND [english]/lim AND [2019-2023]/py	5073
#18	#10 AND #15 AND [english]/lim AND [2019-2023]/py AND ([conference abstract]/lim OR [conference paper]/lim OR [conference review]/lim)	994
#19	#17 NOT #18	4079

3. Cochrane Library

Interface: Wiley		Field labels
Date of Search: 14 March 2024		<ul style="list-style-type: none">ti,ab,kw = title, abstract and author keywordsNEAR/x = within x words, regardless of order* = truncation of word for alternate endings
Number of hits: 323		
#	Searches	Results
#1	[mh ^COVID-19]	7483
#2	[mh "COVID-19 Testing"]	131
#3	[mh ^"COVID-19 Vaccines"]	616
#4	[mh ^SARS-CoV-2]	3126
#5	(([mh ^Coronavirus] OR [mh ^Betacoronavirus] OR [mh ^"Coronavirus infections"])) AND ([mh ^"Disease outbreaks"] OR [mh ^Epidemics] OR [mh ^Pandemics])	376
#6	(nCov*:ti,ab,kw OR 2019nCov:ti,ab,kw OR 19nCov:ti,ab,kw OR COVID*:ti,ab,kw OR SARS-COV-2:ti,ab,kw OR SARSCOV-2:ti,ab,kw OR SARS-COV2:ti,ab,kw OR SARSCOV2:ti,ab,kw OR "SARS coronavirus 2":ti,ab,kw OR "Severe Acute Respiratory Syndrome Coronavirus 2":ti,ab,kw OR "Severe Acute Respiratory Syndrome Corona Virus 2":ti,ab,kw)	20450
#7	((coronavirus*:ti,ab,kw OR ("corona" NEXT virus*):ti,ab,kw OR betacoronavirus*:ti,ab,kw) AND (pandemic*:ti,ab,kw OR epidemic*:ti,ab,kw OR outbreak*:ti,ab,kw OR crisis:ti,ab,kw))	4451
#8	((Wuhan:ti,ab,kw OR Hubei:ti,ab,kw) NEAR/5 pneumonia:ti,ab,kw)	29
#9	((new:ti,ab,kw OR novel:ti,ab,kw OR 19:ti,ab,kw OR 2019:ti,ab,kw OR Wuhan:ti,ab,kw OR Hubei:ti,ab,kw OR China:ti,ab,kw OR Chinese:ti,ab,kw) NEAR/3 (coronavirus*:ti,ab,kw OR ("corona" NEXT virus*):ti,ab,kw OR betacoronavirus*:ti,ab,kw OR CoV:ti,ab,kw OR HCoV:ti,ab,kw))	9837
#10	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9	20981
#11	[mh ^"Cost-Effectiveness Analysis"]	103
#12	[mh ^"Cost-Benefit Analysis"]	11368
#13	((cost?:ti,ab,kw NEAR/3 (benefit*:ti,ab,kw OR effect*:ti,ab,kw OR utilit*:ti,ab,kw OR minimi*:ti,ab,kw OR consequence*:ti,ab,kw)) AND analy*:ti,ab,kw)	30847
#14	(economic:ti,ab,kw NEAR/3 evaluat*:ti,ab,kw)	5793
#15	(cost-benefit*:ti,ab,kw OR cost-effectivenes*:ti,ab,kw OR cost-utility*:ti,ab,kw OR cost-minimi?ation*:ti,ab,kw OR cost-consequence*:ti,ab,kw)	32461
#16	#11 OR #12 OR #13 OR #14 OR #15	38315
#17	#10 AND #16 NOT (clinicaltrials or trialsearch):so	323

4. Web of Science Core Collection

Interface: Clarivate Analytics		Field labels	
Editions = A&HCI , ESCI , SCI-EXPANDED , SSCI		<ul style="list-style-type: none"> • TS/Topic = title, abstract, author keywords and Keywords Plus • NEAR/x = within x words, regardless of order • * = truncation of word for alternate endings 	
Date of Search: 14 March 2024		Note: the <i>Exact search</i> -function was used for all the searches	
Number of hits: 2 852			
#	Searches	Results	
1	TS=(nCoV* OR 2019nCoV OR 19nCoV OR COVID* OR SARS-COV-2 OR SARSCOV-2 OR SARS-COV2 OR SARSCOV2 OR "SARS coronavirus 2" OR "Severe Acute Respiratory Syndrome Coronavirus 2" OR "Severe Acute Respiratory Syndrome Corona Virus 2")	520593	
2	TS=((coronavirus* OR "corona virus*" OR betacoronavirus*) AND (pandemic* OR epidemic* OR outbreak* OR crisis))	95256	
3	TS=((Wuhan OR Hubei) NEAR/4 pneumonia)	461	
4	TS=((new OR novel OR 19 OR 2019 OR Wuhan OR Hubei OR China OR Chinese) NEAR/2 (coronavirus* OR "corona virus*" OR betacoronavirus* OR CoV OR HCoV))	106202	
5	#4 OR #3 OR #2 OR #1	532699	
6	TS=((cost\$ NEAR/2 (benefit* OR effect* OR utilit* OR minimi* OR consequence*)) AND analy*)	182784	
7	TS=(economic NEAR/2 evaluat*)	37381	
8	TS=(cost-benefit* OR cost-effectiveness* OR cost-utility* OR cost-minimization* OR cost-consequence*)	160818	
9	#8 OR #7 OR #6	277367	
10	#9 AND #5	2900	
11	#9 AND #5 and 2019 or 2020 or 2021 or 2022 or 2023 or 2024 (Publication Years)	2884	
12	#9 AND #5 and 2019 or 2020 or 2021 or 2022 or 2023 or 2024 (Publication Years) and English (Languages)	2852	

Table S1. World Bank Economy Groups of economies

Economy Classification ^a	Gross national income (GNI) per capita (US\$) ^b
Low-income economy (LIE)	$\leq 1,135$
Lower-middle-income economy (LMIE)	1,136 ~ 4,465
Upper-middle-income economy (UMIE)	4,466 ~ 13,845
High-income economy (HIE)	$\geq 13,846$

a. Fiscal year 2024

b. Fiscal year 2022

Table S2. Characteristics of the included studies

Author	Year	Country/Area	Economy ^a	Perspective	Time horizon	Discount rate ^b		Economic evaluation ^c	WTP	Population	Population size ^d	Intervention ^e	Comparator ^f	Measure of effectiveness ^g	INB (US\$) ^h	SD of INB (US\$) ⁱ	JBI score
						Cost	Utility										
Atherly ¹	2023	US	HI	Societal	2 years	NA	NA	CEA	73309 USD	General population	330 M	Hospital improvement	NI	QALY	926.99	141.89	8
												NMIs			-6677.38	1022.05	
												Vaccines			187.17	28.65	
												NMIs+Hospital improvement			-5119.98	783.67	
												NMIs+Vaccine			-6243.39	955.62	
												Hospital improvement+Vaccine			712.31	109.03	
												NMIs+Hospital improvement+Vaccine			-5342.65	817.75	
Augustovski ²	2023	Argentina	UMI	Health sector	1 year	No	3%	CEA	10636 USD	General population	29.78 M	Vaccination campaign	NI	QALY	728.92	120.56	10
		Brazil	UMI						7697 USD		150.03 M				218.17	17.47	
		Chile	HI						16247 USD		13.45 M				319.18	52.19	
		Colombia	UMI						6183 USD		36.06 M				421.37	59.96	
		Costa Rica	UMI						12537 USD		3.56 M				548.25	86.34	
		Mexico	UMI						10046 USD		84.89 M				666.07	88.83	
		Peru	UMI						6635 USD		22.25 M				574.91	94.55	
Bagepally ³	2021	India	LMI	Health sector	1 year	No	No	CEA	142719 INR	General population	1 M	Mask	NI	QALY	-3391.39	2767.67	10
												Hand hygiene			-119.29	23.36	
Bartsch ⁴	2024	US	HI	Societal	3 months	NA	NA	CEA	50000 USD	Nursing home residents	100	Testing	NI	QALY	-990.24	335.27	7
				Health sector											-128.35	157.60	
Broughel ⁵	2021	US	HI	Societal	NA	NA	5%	CBA	50000 USD	General population	329.5 M	Suppression	NI	QALY	1461.34	218.65	8
Cai ⁶	2023	Singapore	HI	Societal	1 month	3%	3%	CEA	59798 USD	General population	5.454 M	Border control	NI	QALY	10.92	2.88	10
		Thailand	UMI						7189 USD		71.6 M				8.91	0.86	
Choi ⁷	2023	South Korea	HI	Societal	1 year	NA	NA	CEA	34998 USD	General population	51.29 M	Enhanced vaccination	Vaccination	QALY	25.08	8.36	8
				Health sector											5.36	3.99	
Cook ⁸	2021	Australia	HI	Health sector	1 year	No	No	CBA	NA	General population	2590290	Herd immunity	NI	VSL	1271.01	131.29	9
												Suppression			2729.98	398.51	
Debrabant ⁹	2021	Denmark	HI	Health sector	6 months	NA	0-4%	CEA	398314 DKK	General population	5.831 M	Vaccine	NI	QALY	15.84	38.60	8
Di Fusco ¹⁰	2023	US	HI	Payer	1 year	3%	3%	CEA	50000 USD	General population	310.184 M	Single booster	No booster	QALY	67.99	39.80	10

				Societal											110.25	41.60	
Drakesmith ¹¹	2022	UK	HI	Health sector	NA	No	1.5%	CEA	60000 GBP	General population	22021	Mass LFD testing	Normal testing	QALY	479.17	73.04	7
Du ¹²	2023	India	LMI	Health sector	200 days	NA	3%	CEA	Varied	General population	1.366 B	Fractional vaccine booster	Standard vaccine booster	YLL	11.70	30.14	9
Du (1) ¹³	2022	India	LMI	Health sector	NA	NA	3%	CEA	Varied	General population	1.366 B	Fractional vaccine	NI	YLL	52.24	52.35	8
Du (2) ¹⁴	2022	US	HI	Direct societal	150 days	NA	3%	CEA	100000 USD	General population	328 M	Proactive testing	Normal testing	YLL	6502.69	2734.44	8
Du ¹⁵	2021	US	HI	Health sector	150 days	NA	3%	CEA	100000 USD	General population	328.2 M	Expanding PCR testing	NI	YLL	6222.16	3747.91	9
Fernandes ¹⁶	2022	Brazil	UMI	Health sector	1 year	No	No	CEA	17586 USD		NA	Vaccine	NI	QALY	16.58	16.76	7
Ferranna ¹⁷	2023	US	HI	Payer	6 months	3%	3%	CBA	NA	Employees	332 M	Vaccine mandate	No vaccine mandate	QALY	410.00	214.68	8
Fu ¹⁸	2022	China	UMI	Societal	1 year	No	No	CEA	12556 USD	General population	NA	Booster	No booster	QALY	1046.02	604.27	8
Fust ¹⁹	2024	Japan	HI	Health sector	1 year	No	2%	CEA	5000000 JPY	General population	124.97 M	Enhanced vaccination	NI	QALY	121.61	38.12	8
				Societal											156.08	38.12	
Gandjour ²⁰	2022	Germany	HI	Societal	5 years	3%	2%	CEA	101493 USD	General population	NA	Vaccine	Partial lockdown	QALY	895.61	374.70	8
Gandjour ²¹	2023	Germany	HI	Societal	1 and 5 years	3%	2%	CEA	101493 EUR	General population	NA	Lockdown+successful revaccination	NI	LY	2431.17	2505.85	8
Gonzalez Lopez-Valcárcel ²²	2021	Spain	HI	Health sector	2 years	3%	3%	CEA	25000 EUR	General population	46940000	TTQ	NI	QALY	6.08	2.25	7
Guzman Ruiz ²³	2022	Colombia	UMI	Societal	1 year	NA	3%	CEA	6436 USD	General population	50.3 M	TTI	NI	QALY	11334.13	1303.35	8
				Health sector											10764.07	1303.35	
Hagens ²⁴	2021	Turkey	UMI	Societal	1 year	3%	3%	CEA	9127 USD	General population	83429615	Vaccine	NI	QALY	649.48	36.19	8
				Health sector											425.21	23.68	
Hanig ²⁵	2023	US	HI	Societal	NA	NA	NA	CBA	Varied	General population	1.2 M	Improved public transportation	NI	VSL	-4.43	53.85	8
Heatley ²⁶	2022	New Zealand	HI	Societal	NA	No	No	CBA	73450 NZD	General population	5.124 M	Lockdown	Limited opening	QALY	-111.90	330.18	6
Jiang ²⁷	2022	Hong Kong	HI	Societal	1 year	3%	3%	CEA	49800 USD	General population	100000	Vaccine	NI	QALY	639.64	208.55	10
		Indonesia	UMI						4332 USD						173.20	74.64	
		China	UMI						12556 USD						146.03	58.31	
		Philippines	LMI						3460 USD						295.59	156.72	
		Singapore	HI						72794 USD						441.05	212.45	
		Thailand	UMI						7066 USD						238.57	94.26	
Joshi ²⁸	2024	Germany	HI	Health sector	1 year	No	3%	CEA	50000 USD	General population	83.329 M	Enhanced vaccination	Vaccine	QALY	76.06	2.06	9
Karnon ²⁹	2022	Australia	HI	Societal	6 months	NA	NA	CBA	50000 AUD	General population	26.26 M	Testing	NI	QALY	7947.66	8677.55	7
Kirson ³⁰	2022	US	HI	Societal	3.5 years	3%	3%	CBA	150000 USD	General population	330 M	Vaccine	NI	LY	15151.50	7606.68	7

Kirwin ³¹	2021	Canada	HI	Payer	NA	1.5%	1.5%	Net benefit	30000 CAD	General population	4.371 M	Vaccine	NI	QALY	52.47	26.67	8
Kohli ³²	2023	US	HI	Health sector	1 year	No	3%	CEA	81630 USD	General population	335.942	Enhanced vaccination	NI	QALY	125.44	18.83	10
				Societal											160.14	18.83	
Kohli (1) ³³	2021	US	HI	Health sector	1 year	NA	3.0%	CEA	50000 USD	General population	326.8 M	Vaccine	NI	QALY	106.08	24.91	9
Kohli (2) ³⁴	2021	UK	HI	Health sector	10 years	3.5%	3.5%	CEA	25000 GBP	General population	66.84 M	Expanding vaccine	Vaccine	QALY	4.62	0.87	8
				Societal											7.94	0.87	
Li ³⁵	2024	US	HI	Health sector	180 days	1.5%	1.5%	CEA	50000 USD	General population	331.89 M	Enhanced vaccination	NI	QALY	16.01	9.22	9
Li ³⁶	2023	Australia	HI	Health sector	180 days	3%	3%	CEA	50000 AUD	General population	26 M	Vaccine booster	Vaccine	QALY	25.63	12.49	9
Li ³⁷	2022	US	HI	Health sector	180 days	3%	3%	CEA	50000 USD	General population	100000	Vaccine booster	Vaccine	QALY	33.20	59.70	8
Lopez Segui (1) ³⁸	2021	Spain	HI	Health sector	NA	NA	3%	CBA	25000 EUR	General population	124865	Mass testing	Normal testing	QALY	54.92	13.41	8
Lopez Segui (2) ³⁹	2021	Spain	HI	Societal	NA	No	No	CBA	25000 EUR	General population	1986032	Vaccine	NI	QALY	298.96	86.74	8
				Health sector											51.07	26.08	
Lou ⁴⁰	2023	Singapore	HI	Societal	1 month	No	3%	CBA	75000 USD	General population	5.64 M	Testing+quarantine for travelers	NI	QALY	68.45	115.97	9
												Quarantine for travelers			208.99	248.76	
Mar ⁴¹	2024	Spain	HI	Health sector	6 months	NA	3%	CEA	25000 EUR	General population	2435495	Vaccine	NI	QALY	232.88	76.71	9
Marco-Franco ⁴²	2021	Spain	HI	Buyer	NS	NA	3-4%	CEA	22000-33000 EUR	General population	47.37 M	Vaccine	NI	QALY	4571.67	399.75	8
Maya ⁴³	2022	US	HI	Societal	NA	NA	3%	CEA	70219 USD	School student	1000	PCR and/or Antigen test	NI	QALY	-8.68	5.73	8
Miles ⁴⁴	2021	UK	HI	Societal	NA	NA	NA	CBA	30000 GBP	General population	67.1 M	Lockdown	NI	QALY	-8239.32	3336.85	7
Mol ⁴⁵	2023	Denmark, Sweden	HI	Societal	6 months	No	NA	CEA	100000 USD	General population	5.8 M, 10.1 M	Lockdown	NI	LY	-214.48	1826.45	8
Morales-Zamora ⁴⁶	2022	Colombia	UMI	Health sector	3 years	No	No	CEA	5304.3 USD	General population	50.93 M	Vaccine	NI	DALY	4.60	33.08	9
Neilan ⁴⁷	2021	US	HI	Health sector	180 days	No	3%	CEA	100000 USD	General population	6.9 M	Expanding PCR testing	Hospitalized testing	QALY	317.96	313.31	8
Nguyen ⁴⁸	2022	Australia	HI	Societal	118 days	No	No	CEA	Varied	General population	2393	Social distancing	No social distancing	DALY	1083.97	1185.79	8
Nurchis ⁴⁹	2022	Italy	HI	Societal	3 months	No	3%	CBA	NA	Healthcare worker	5152	Vaccination campaign	NI	PL	2779.16	51.73	8
Orangi ⁵⁰	2022	Kenya	LMI	Societal	1.5 years	3%	3%	CEA	3000 USD	General population	47.56 M	Vaccine	no vaccine	DALY	31.37	4.29	9
Orlewska ⁵¹	2022	Poland	HI	Payer	1 year	NA	3.5%	CEA	147024 PLN	General population	37.75 M	Vaccine	no vaccine	QALY	1391.29	53.28	8
Padula ⁵²	2021	US	HI	Health sector	1 year	NA	NA	CEA	100000 USD	General population	330 M	Vaccine	No vaccine	QALY	2279.25	125.04	8
Patenaude ⁵³	2022	US	HI	Health sector	78 days	NA	NA	CBA	NA	General population	331.9 M	Oral vaccine	Vaccine	Case averted	1.40	0.27	8
				Societal											127.61	357.77	
Pearson ⁵⁴	2021	Pakistan	LMI	Health sector	10 years	3%	3%	CEA	1322 USD	General population	48 M	Vaccine	NI	DALY	6.94	10.13	10
Reddy (1) ⁵⁵	2021	South Africa	UMI	Health sector	1 year	No	No	CEA	7055 USD	General population	59 M	Vaccine	NI	YLL	358.83	144.77	8

Reddy (2) ⁵⁶	2021	South Africa	UMI	Health sector	1 year	No	3%	CEA	3250 USD	General population	11 M	Testing+Contact tracing	Testing alone	LY	155.07	72.10	8
Ruiz ⁵⁷	2023	Nigeria	LMI	Health sector	1 year	3%	3%	CEA	2097 USD	General population	107.1 M	Vaccine	No vaccine	DALY	3.59	24.72	10
Sandmann ⁵⁸	2021	UK	HI	Health sector	10 years	3.5%	3.5%	CEA	20000 GBP	General population	67 M	Vaccine+physical distancing	No intervention	QALY	2204.55	1876.68	8
Scherbina ⁵⁹	2021	US	HI	Societal	NA	NA	3%	CBA	150000 USD	General population	332 M	Lockdown	No lockdown	QALY	570.67	492.14	7
Schonberger ⁶⁰	2020	US	HI	Societal	11.1 months	3%	3%	CBA	125000 USD	General population	329 M	Limited opening	Full opening	QALY	2918.82	426.07	9
Sirison ⁶¹	2023	Thailand	UMI	Provider	170 days	3%	3%	CEA	1359 USD	General population	50 M	Vaccine booster	No booster	Case averted	76.94	1.56	7
Suwantika ⁶²	2022	Indonesia	UMI	Societal	1 year	NA	NA	CEA	NA	General population	271.6 M	Social distancing	NI	Death averted	6501.05	1886.51	8
Szanyi ⁶³	2023	Australia	HI	Societal	1 year	3%	3%	CEA	70000 AUD	General population	6.6 M	Vaccine booster	No booster	HALY	75.39	41.57	8
				Health sector											9.79	16.49	
Tan ⁶⁴	2023	China	HI*	Societal	82 days	NA	NA	CEA	173630 CNY	General population	24.89 M	Dynamic zero	NI	DALY	5255.50	493.14	10
													Lockdown		684.63	471.23	
Tuite ⁶⁵	2024	Canada	HI	Societal	Lifetime	1.5%	1.5%	CBA	30000 CAD	General population	38.45 M	Vaccine	NI	QALY	6760.74	2704.12	10
Vaezi ⁶⁶	2021	Iran	LMI	Health sector	NA	NA	NA	CEA	2282 USD	General population	79.9 M	Vaccine	NI	DALY	2.91	2.00	6
Viches ⁶⁷	2022	Canada	HI	Societal	1 year	1.5%	1.5%	CEA	30000 CAD	People at workplace	100,000	RA screening in workplaces	TOSC	QALY	-5.09	91.33	8
				Health sector											9.75	57.60	
Wang W ⁶⁸	2021	Taiwan	HI	Societal	180 days	No	No	CUA	28707 USD	General population	8362864	Vaccine	NI	QALD	689.81	120.99	8
Wang X ⁶⁹	2022	China	UMI	Provider	NA	No	No	CEA	12556 USD	Audience of competition events	5000	close-contact control	NI	Infection averted	14526.75	15452.44	8
Wang Y ⁷⁰	2022	Thailand	UMI	Societal	1 year	NA	NA	CEA	160000 THB	General population	71.6 M	Vaccine	NI	LY	177.36	207.01	8
Xiong ⁷¹	2022	Hong Kong	HI	Health sector	1 year	NA	NA	CEA	1000000 HKD	General population	7346100	Vaccine	NI	QALY	266.11	271.50	8
Zafari ⁷²	2022	US	HI	Societal	1 year	3%	3%	CEA	63530 USD	Customers in restaurants	30	Improving ventilation	NI	QALY	8581.98	4302.44	9
Zafari ⁷³	2021	US	HI	Societal	90 days	No	3%	CEA	200000 USD	University students and staff	20500	Symptom-checking app	NI	QALY	55.94	72.98	8
												Thermal camera			-76.95	42.95	
												Gateway testing			183.66	257.46	
												Standardized masks			461.11	514.91	
												Weekly testing			-79.63	301.81	
												Package intervention			98.52	61.97	
Zhao ⁷⁴	2021	China	UMI	Health sector	60 days	NA	3%	CEA	70892 CNY	General population	1.336 B	Movement restriction	NI	DALY	2669.27	3541.67	10
				Societal											20976.23	19793.70	
Zhou ⁷⁵	2023	China	UMI	Societal	1 year	5%	5%	CUA	72000 CNY	General population	1.33 B	Vaccination	NI	QALY	18628.56	20310.31	11

- a. HI, hi-income; LMI, lower-middle-income; UMI, upper-middle-income
- b. NA, not available
- c. CEA, cost-effectiveness analysis; CBA, cost-benefit analysis; CUA, cost-utility analysis
- d. M, million; B, billion
- e. NMIs, non-medical interventions; TTQ, test-tracking-quarantine; TTI, test, trace, and isolate
- f. NI, null intervention; TOSC, RT-PCR testing of only severe symptomatic cases
- g. QALY, quality-adjusted life year; VSL, value of statistical life; YLL, year of life lost; LY, life year; DALY, disability-adjusted life year; PL, productivity loss; HALY, health-adjusted life year; QALD, quality-adjusted life day
- h. INB, incremental net benefit, adjusted for purchasing power parity
- i. SD, standard deviation
- * The study was conducted in Shanghai, China, therefore the economy group was assigned as high-income.

Table S3. Definitions of the preventive COVID-19 interventions compared in the included studies

Intervention	Definition
Border control	Repeated testing and necessary quarantine were implemented for cross-border travelers to minimize the importation of cases into the local community. ⁶
Close-contact control	Increasing nucleic acid testing (NAT) frequency among sports competition participants. If an infection was detected, the affected individual was quarantined, and the entire sports delegation associated with the quarantined case underwent additional testing. ⁶⁹
Dynamic zero	A strategy implemented by Shanghai, China during the COVID-19 pandemic aimed to quickly identify and isolate COVID-19 cases. This approach was flexible, allowing for short-term increases in cases but emphasizing rapid response measures to control outbreaks. Key tactics included mass testing, stringent quarantine and isolation protocols, travel restrictions, localized lockdowns, and the use of technology for contact tracing and movement control. ^{64,76}
Enhanced vaccination	Including provide further vaccination after Omicron BA.1/2 variant ⁶³ , booster vaccination ^{10,36,37,61} (including fractional dosing booster ¹²), vaccine mandates ¹⁷ , vaccination campaign ^{2,49} , sequential vaccination ¹⁸ , expanding influenza vaccination ³⁴ ,
Entry testing	See “Gateway testing”.
Expanding testing	The method to increase the scope or frequency of the COVID-19 testing, including surveillance testing ¹⁵ , proactive testing ¹⁴ , whole-area (or mass) testing ^{11,38} ,
Expanding influenza vaccination	Continuing to vaccinate all in age group 50 to 64 years with a quadrivalent cell-based vaccine (QIVc). ³⁴
Fractional dosing booster	Administering a lower dose (1/8~1/2) of a vaccine as a booster shot compared to the original full dose given during the initial vaccination series. ¹²
Gateway testing	Testing individuals for the virus as they enter a specific area, facility, or country, designed to identify infected persons at points of entry—such as airports, borders, universities, workplaces, or events—to prevent them from introducing the virus into the new environment. ⁷³
Hand hygiene	The practice of regularly cleaning one’s hands to prevent the spread of the coronavirus. ³
Herd immunity	It occurs when large portion of a community becomes immune to a disease, making the spread of the disease from person to person unlikely. ⁸
Heterologous booster	Administering a booster dose of a COVID-19 vaccine that is different from the vaccine used for the initial vaccination series. ¹⁸
Homogeneous booster	Administering a booster dose of a COVID-19 vaccine that is the same type as the vaccine used in the initial vaccination series. ¹⁸
Hospital improvement (HI)	Improvement in hospital therapeutics and care. ¹
Hospitalized testing	Polymerase chain reaction (PCR) testing only for patients with severe/critical symptoms warranting hospitalization. ⁴⁷
Improved public transportation	To prevent crowding, transportation companies deploy autonomous vehicles, add extra buses, or utilize longer buses. ²⁵
Improving ventilation	Improving the indoor air ventilation using standalone filtration systems containing high efficiency particulate air or electrostatic units in poorly ventilated indoor commercial spaces. ⁷²
Limited opening	The phased and controlled reopening of businesses, services, and public spaces following full or partial lockdowns in the US during the COVID-19 pandemic. ⁶⁰
Lockdown	Imposition of strict restrictions on movement, social interactions, and economic activities by authorities to control the spread of the coronavirus. It typically involves closing non-essential businesses, restricting gatherings, halting public events, and limiting or completely stopping people's movement except for essential purposes such as healthcare, groceries, or work deemed essential. ^{21,44,59} Partial lockdown ²⁰ , and strict dynamic zero ⁶⁴ were treated as lockdown in current study
Masks	Using surgical or N95 or standardized high-filtration masks to reduce the risk of infectious droplets spreading from person to person. ^{3,73}

Mass testing	Testing all individuals within a specific geographic area or community for COVID-19, regardless of whether they are showing symptoms of the disease.
Movement restriction	Measures implemented by governments and health authorities to limit the movement of people within and between areas to control the spread of the virus, often including travel bans, quarantine and isolation orders, social distancing, lockdowns, etc. ⁷⁴
Null intervention (NI)	The comparator group did not adopt any intervention or a specified intervention; however, general preventive measures as suggested locally or recommended by the World Health Organization were possibly adopted.
Nonmedical interventions (NMIs)	Measures to limit the physical contact of individuals (such as stay-at-home orders, the closing of schools, cancellation of public events, restrictions on social gatherings, closing public transportation, travel restrictions, and closing of nonessential businesses) and to reduce the probability of transmission per individual (such as wearing masks in public, tracking and tracing, and increased testing) ¹ , including package intervention ⁷³ .
Oral vaccine	An experimental oral vaccine against COVID-19, developed using the Vector-Adjuvant-Antigen Standardized Technology (VAAST) platform. ⁵³
Package intervention	A package of common interventions for the prevention of transmission of SARS-CoV-2 virus, excluding vaccines. ⁷³
Partial lockdown	A set of restrictive measures that are less severe than a full lockdown, aimed at slowing the spread of COVID-19, while allowing certain economic and social activities to continue under controlled conditions. ²⁰
Proactive testing	The strategy of actively testing individuals for the virus regardless of whether they show symptoms. ¹⁴
Quarantine	Separating and restricting the movement of traveler across the border for a given period. ⁴⁰
Screening in workplaces	Implementation of frequent rapid antigen testing to detect asymptomatic infection in workplaces. ⁶⁷
Sequential vaccination	Administering a booster with a homogeneous booster or a heterogeneous booster. ¹⁸
Social distancing	Maintaining a physical distance between individuals to reduce the spread of the virus. Recommendations typically included staying at least 1.5~2 meters away from others, avoiding large gatherings, and minimizing social interactions outside of one's household. ⁴⁸
Suppression	Providing police and other services jurisdiction to enforce quarantine and self-isolation measures to contain spread. ⁸
Surveillance testing	In contrast to symptom-based testing and isolation, this approach involves testing all individuals regularly at specified intervals, accompanied by a period of isolation for those who test positive. ¹⁵
Symptom-checking app	A digital tool available on smartphones and tablets that allows users to input their health information and symptoms to assess their risk of having contracted the COVID-19 virus. ⁷³
Testing	Using molecular tests or antigen tests to determine if an individual was infected with the SARS-CoV-2 virus, including those without symptom. ^{43,73}
Thermal camera	The cameras equipped with infrared technology to detect elevated body temperatures in individuals as part of efforts to identify possible infections. ⁷³
Testing of only severe symptomatic cases (TOSC)	Test only severe symptomatic cases. RT-PCR testing was implemented exclusively for cases exhibiting severe symptoms. ⁶⁷
Vaccination	Administering mRNA ^{39,55,68,71} , viral vector ^{39,55} , protein subunit, or inactivated/killed ²⁷ vaccines to stimulate the immune system to protect against SARS-CoV-2 virus causing COVID-19.
Test, trace, and isolate/quarantine (TTI/TTQ)	Test, trace, and isolate/quarantine, including close-contact control ⁶⁹ . The deployment of testing, contact tracing, isolation/quarantine, and monitoring for cases and their contacts. Once an index case is identified, patients must isolate with their cohabitant contacts. The index case must be monitored for assessment of warning signs or symptoms. Additionally, their close contacts in given days are traced, contacted, tested, and isolated/quarantined. ^{22,23,40,56}
Whole-area testing	See "Mass testing" ¹¹

Figure S1. Comparative cost-effectiveness of preventive COVID-19 interventions vs. NI from a societal perspective. **Panel A.** INB_{PPP}-adjusted. **Panel B.** INB_{WTP}-standardised. CI – confidence interval; HI – hospital improvement; INB – incremental net benefit; MD – mean difference; NI – null intervention; NMIs – nonmedical interventions; PPP – purchasing power parity; TTI – test, trace, and isolate; WTP – willingness to pay.

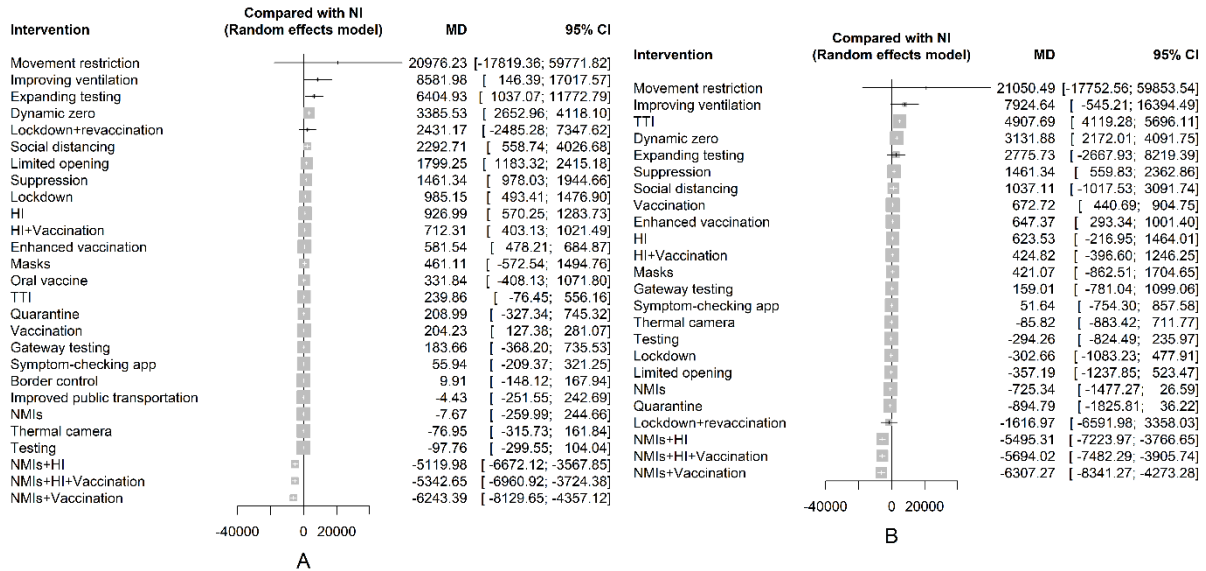


Figure S2. Interventions ranked by certainty of being superior across all comparisons from a societal perspective. **Panel A.** INB_{PPP}-adjusted. **Panel B.** INB_{WTP}-standardised. HI – hospital improvement; INB – incremental net benefit; NMIs – nonmedical interventions; PPP – purchasing power parity; SUCRA – surface under the cumulative ranking curve; TTI – test, trace, and isolate; WTP – willingness to pay.

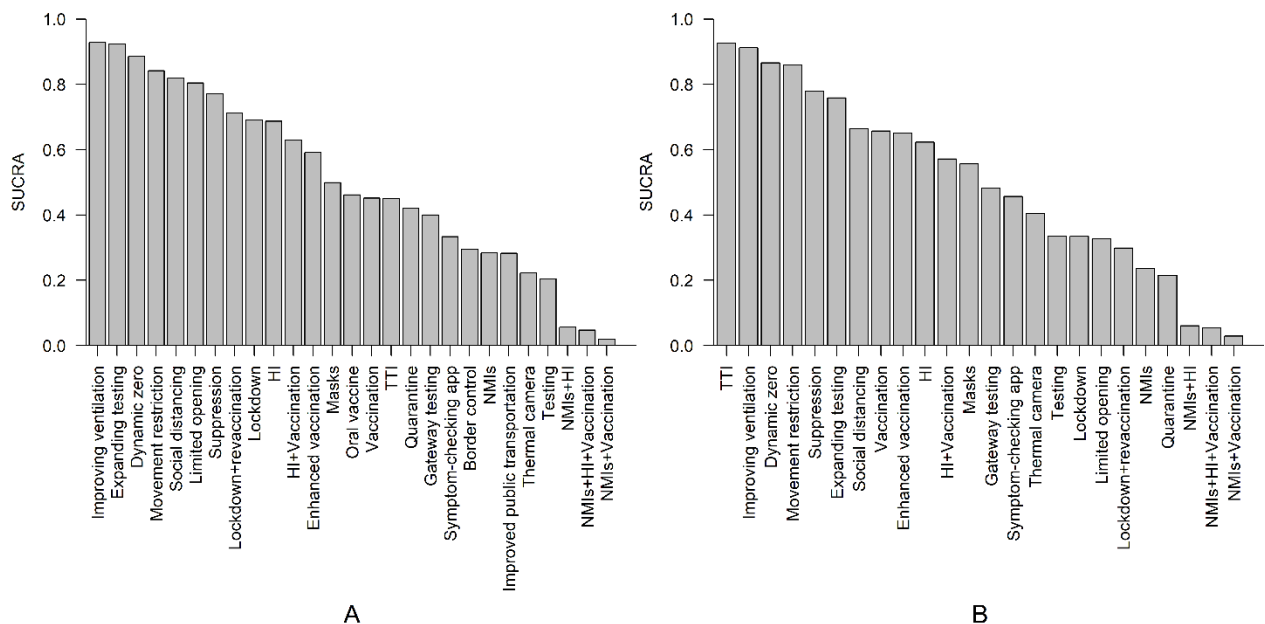


Figure S3. Comparative cost-effectiveness and ranks of the interventions vs. NI following study exclusion from a societal perspective. **Panel A.** Forest plot for INB_{WTP-standardised}. **Panel B.** Rank plot for INB_{WTP-standardised}. CI – confidence interval; HI – hospital improvement; INB – incremental net benefit; MD – mean difference; NI – null intervention; NMIs – nonmedical interventions; PPP – purchasing power parity; SUCRA – surface under the cumulative ranking curve; TTI – test, trace, and isolate; WTP – willingness to pay.

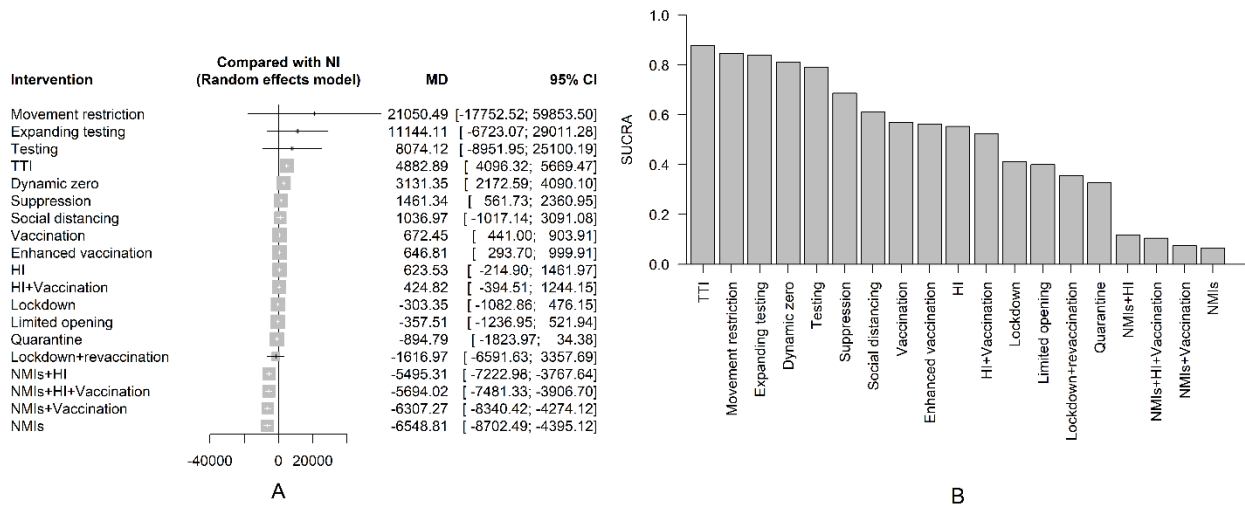


Figure S4. Split effects for highlighted comparisons in the network of societal perspective.

Panel A. INB_{PPP-adjusted}. **Panel B.** INB_{WTP-standardised}. CI – confidence interval; INB – incremental net benefit; MD – mean difference; NI – null intervention; PPP – purchasing power parity; TTI – test, trace, and isolate; WTP – willingness to pay.

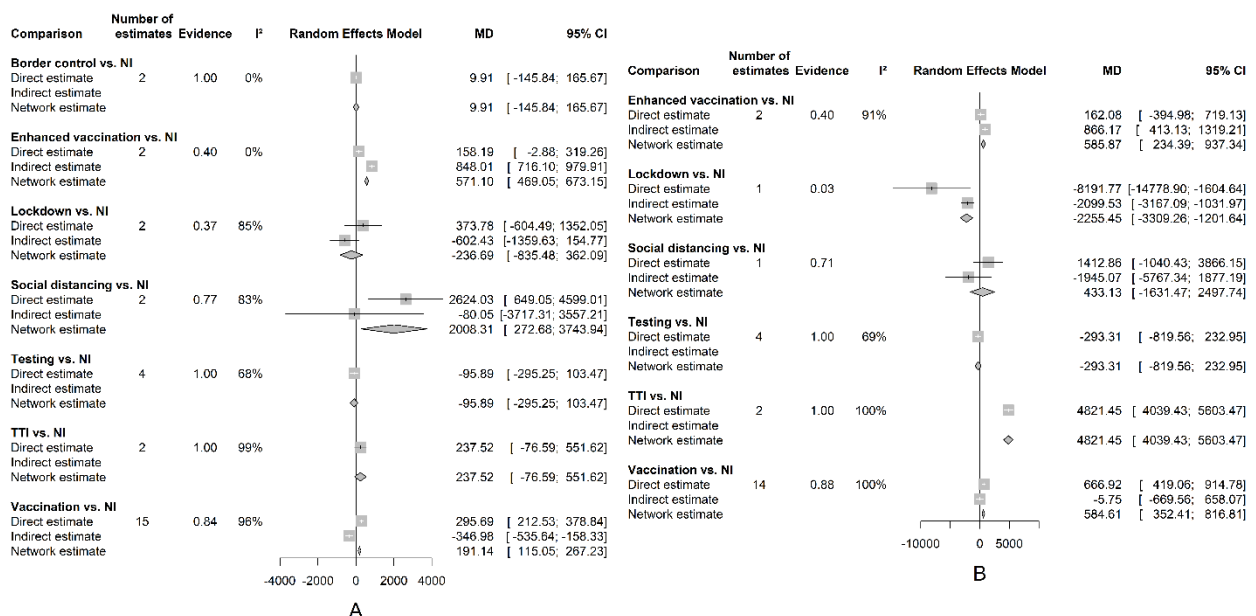


Figure S5. Split effects plot of the interventions in the constrained network of societal perspective. **Panel A.** INB_{ppp}-adjusted. **Panel B.** INB_{WTP}-standardised.

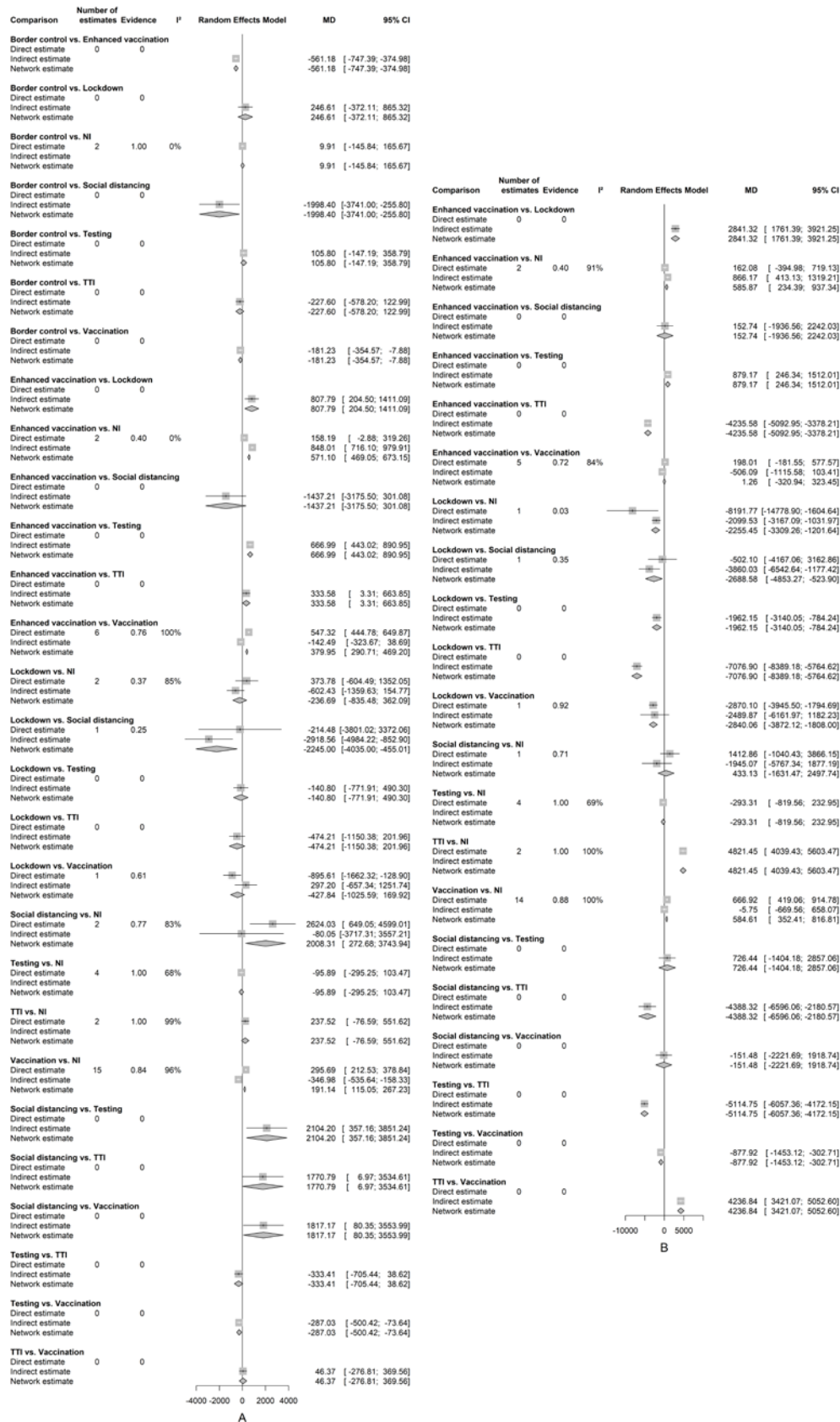


Figure S6. Evidence plot of the interventions in the constrained network of societal perspective

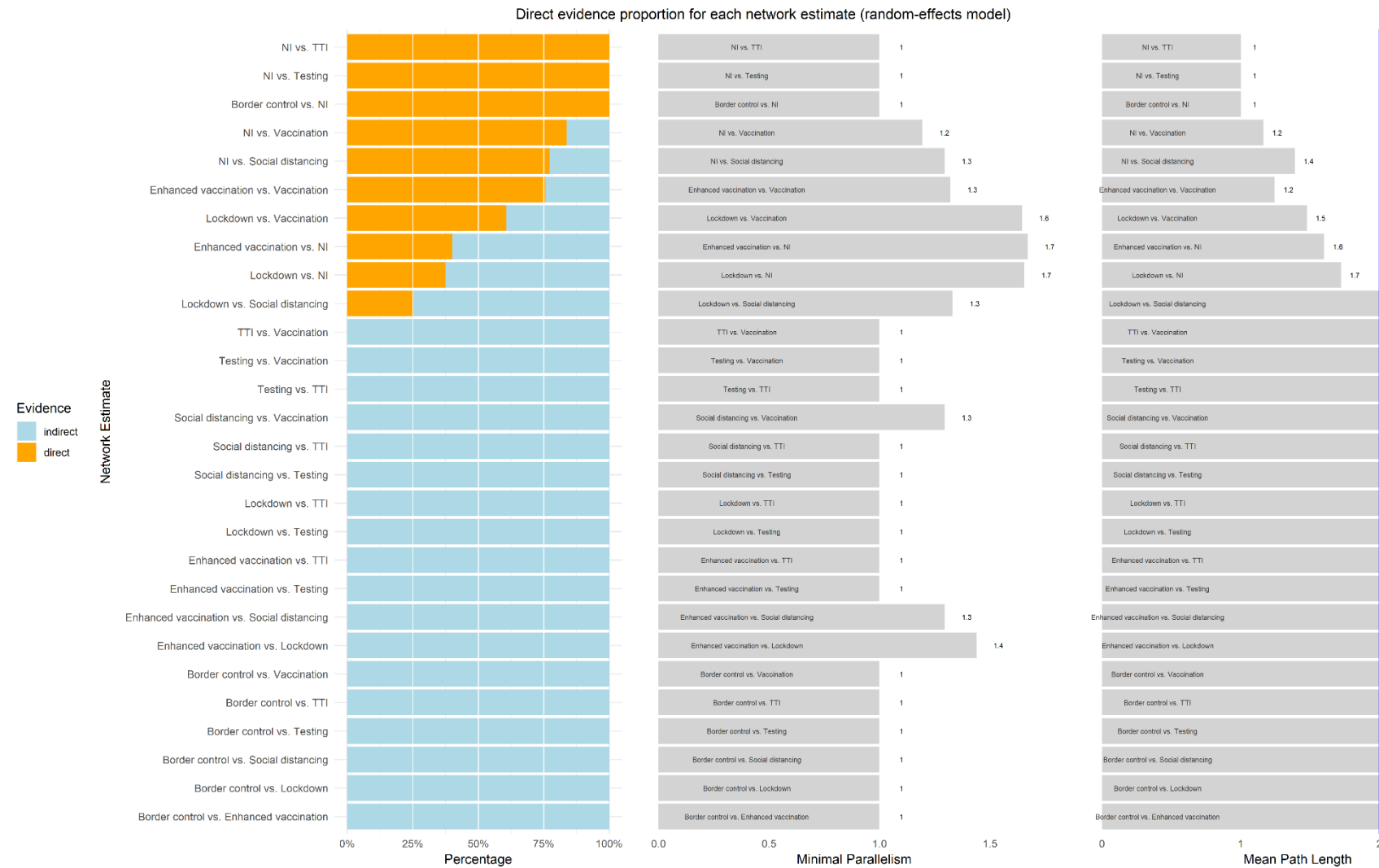


Figure S7. Funnel plots of comparisons among preventive COVID-19 interventions from a healthcare system perspective. **Panel A.** INB_{PPP} -adjusted. **Panel B.** INB_{WTP} -standardised. INB – incremental net benefit; PPP – purchasing power parity; WTP – willingness to pay.

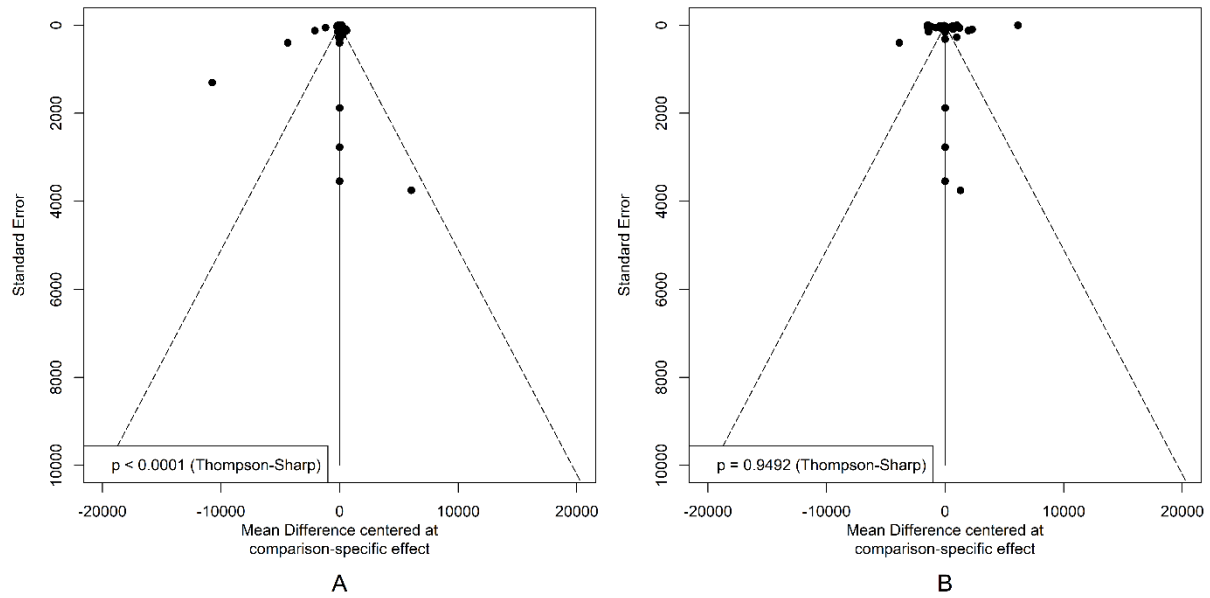


Figure S8. Comparative cost-effectiveness of preventive COVID-19 interventions vs. NI from a healthcare system perspective. **Panel A.** INB_{PPP} -adjusted. **Panel B.** INB_{WTP} -standardised. CI – confidence interval; HI – hospital improvement; INB – incremental net benefit; MD – mean difference; NI – null intervention; NMIs – nonmedical interventions; PPP – purchasing power parity; TTI – test, trace, and isolate; WTP – willingness to pay.

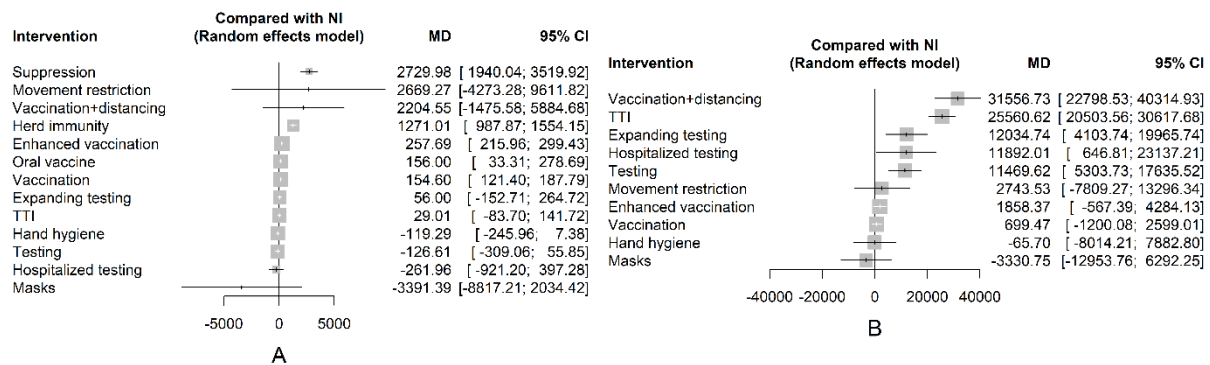


Figure S9. Interventions ranked by certainty of being superior across all comparisons from a healthcare system perspective. **Panel A.** INB_{PPP} -adjusted. **Panel B.** INB_{WTP} -standardised. INB – incremental net benefit; PPP – purchasing power parity; SUCRA – surface under the cumulative ranking curve; TTI – test, trace, and isolate; WTP – willingness to pay.

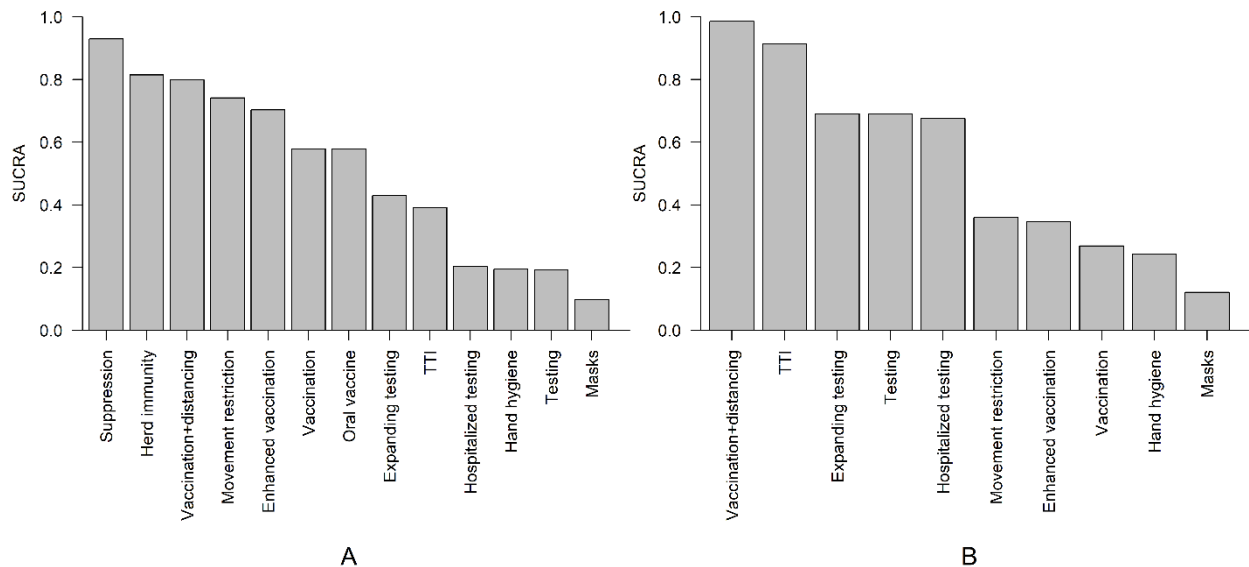


Figure S10. Comparative cost-effectiveness and ranks of the interventions vs. NI following study exclusion, from a healthcare system perspective. **Panel A.** Forest plot for INB_{WTP-standardised}. **Panel B.** Rank plot for INB_{WTP-standardised}. CI – confidence interval; INB – incremental net benefit; MD – mean difference; NI – null intervention; PPP – purchasing power parity; SUCRA – surface under the cumulative ranking curve; TTI – test, trace, and isolate; WTP – willingness to pay.

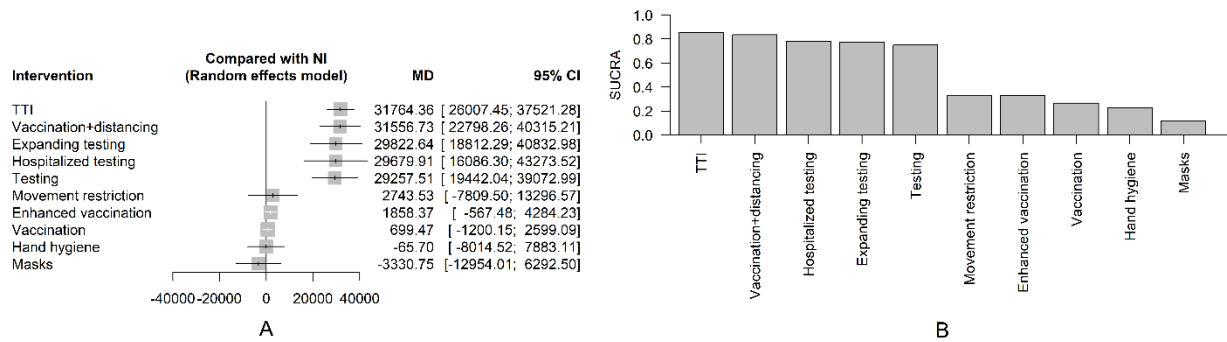


Figure S11. Split effects for highlighted comparisons in the network of healthcare system perspective. **Panel A.** INB_{ppp-adjusted}. **Panel B.** INB_{WTP-standardised}. CI – confidence interval; INB – incremental net benefit; MD – mean difference; NI – null intervention; PPP – purchasing power parity; TTI – test, trace, and isolate; WTP – willingness to pay.

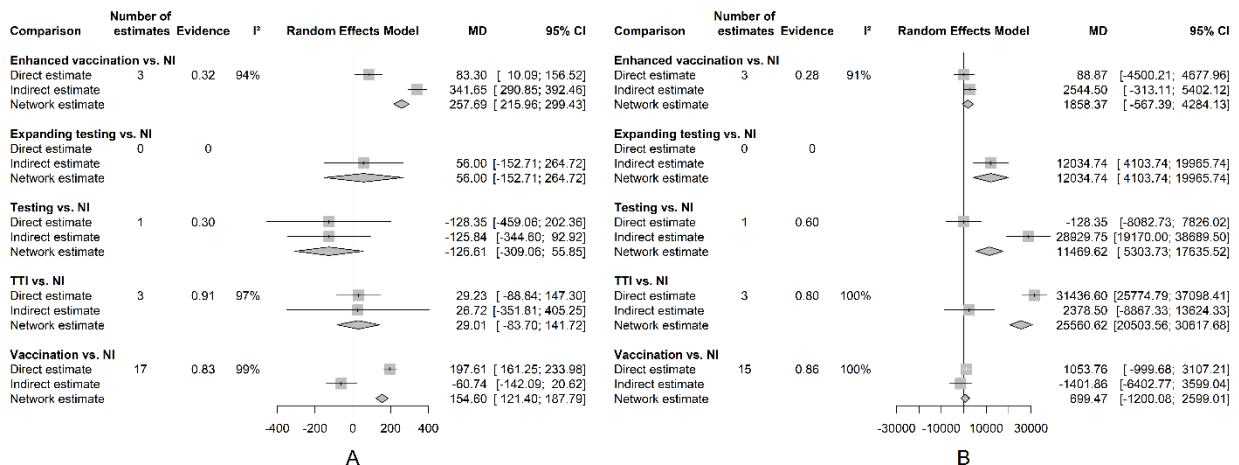


Figure S12. Split effects plot of the interventions in the constrained network of healthcare system perspective. **Panel A.** INB_{PPP} -adjusted. **Panel B.** INB_{WTP} -standardised. CI – confidence interval; MD – mean difference; NI – null intervention; PPP – purchasing power parity; TTI – test, trace, and isolate; WTP – willingness to pay.

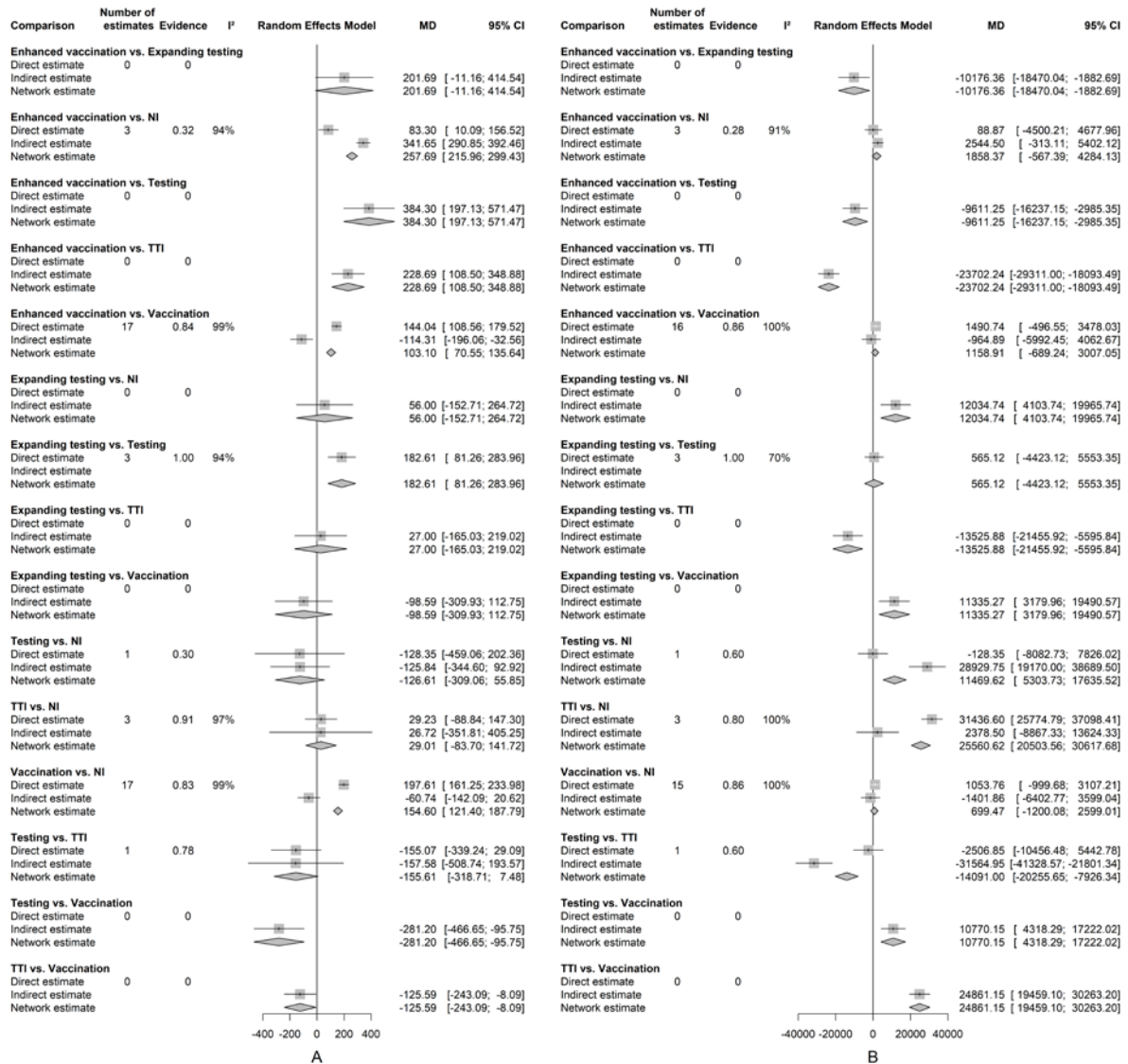


Figure S13. Evidence plot of the interventions in the constrained network of healthcare system perspective. NI – null intervention; PPP – purchasing power parity; TTI – test, trace, and isolate; WTP – willingness to pay.

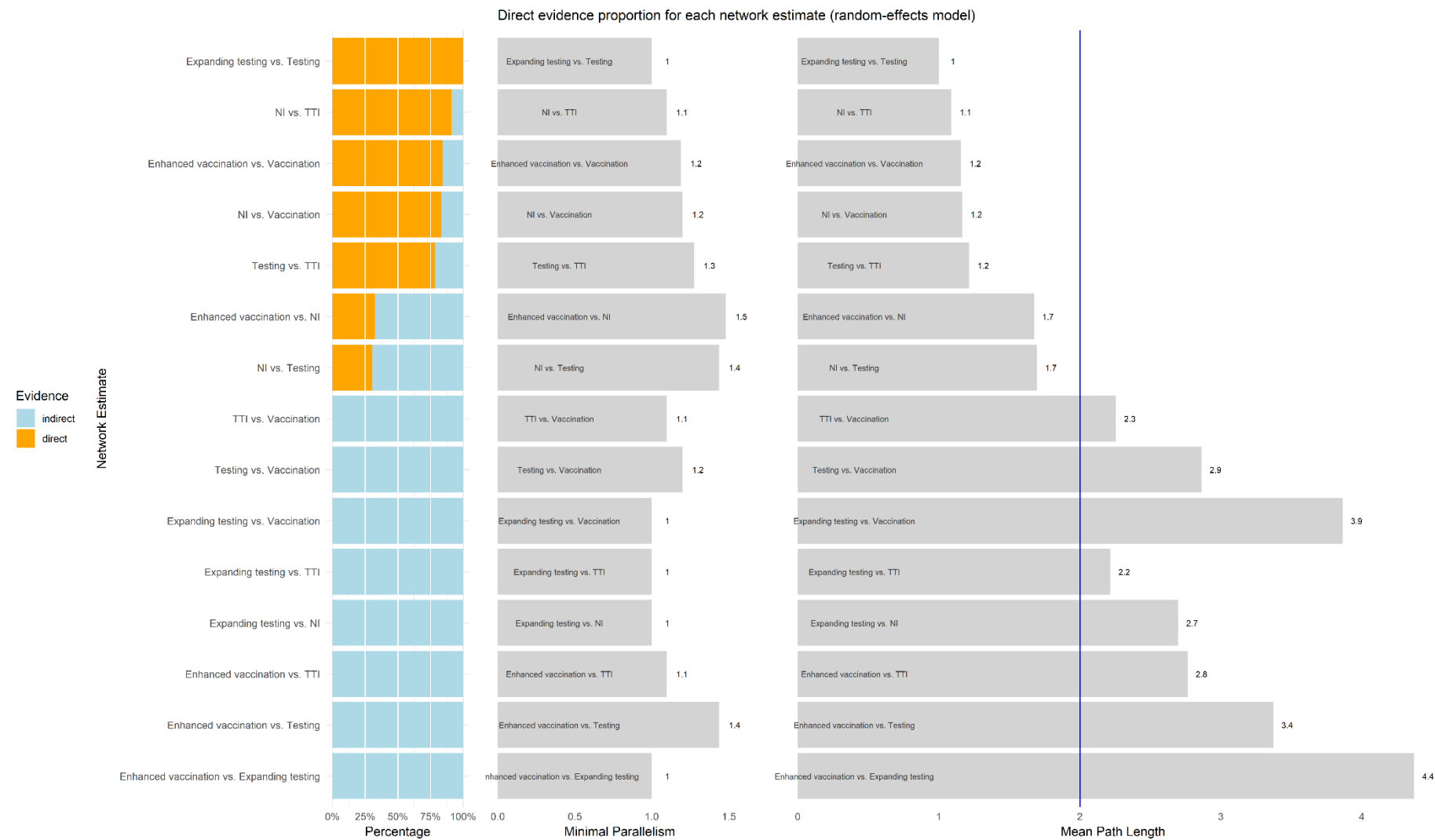


Figure S14. Subgroup analysis by economy levels, societal perspective. **Panel A.** INB_{ppp} -adjusted (HIEs). **Panel B.** INB_{WTP} -standardized (HIEs). **Panel C.** INB_{ppp} -adjusted (UMIEs). **Panel D.** INB_{WTP} -standardized (UMIEs). **Panel E.** INB_{ppp} -adjusted (LMIEs). **Panel F.** INB_{WTP} -standardized (LMIEs). CI – confidence interval; HI – hospital improvement; HIEs – high-income economies; LMIEs – lower-middle-income economies; MD – mean difference; NI – null intervention; NMIs – nonmedical interventions; TTI – test, trace, and isolate; UMIEs – upper-middle-income economies

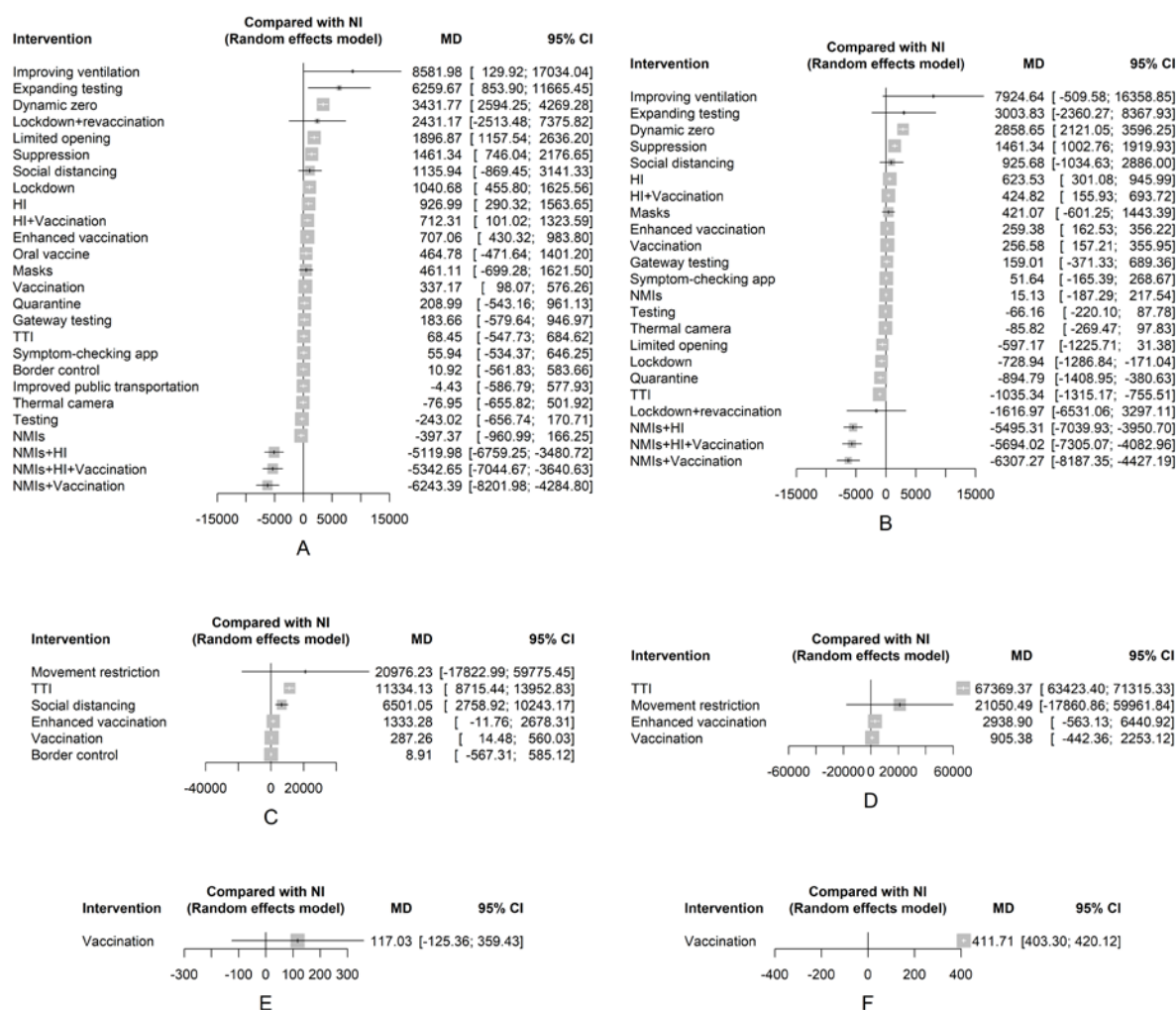
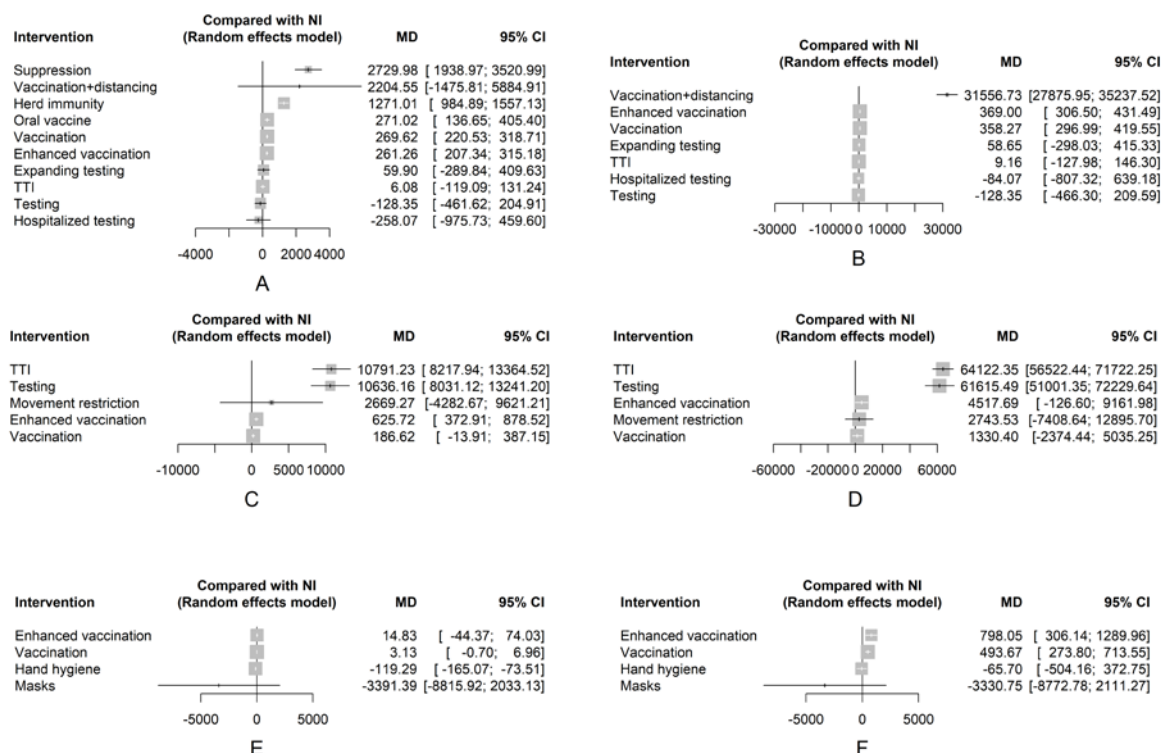


Figure S15. Subgroup analysis by economy levels, healthcare system perspective. **Panel A.** INB_{ppp} -adjusted (HIEs). **Panel B.** INB_{WTP} -standardized (HIEs). **Panel C.** INB_{ppp} -adjusted (UMIEs). **Panel D.** INB_{WTP} -standardized (UMIEs). **Panel E.** INB_{ppp} -adjusted (LMIEs). **Panel F.** INB_{WTP} -standardized (LMIEs). CI – confidence interval; HIEs – high-income economies; LMIEs – lower-middle-income economies; MD – mean difference; NI – null intervention; TTI – test, trace, and isolate; UMIEs – upper-middle-income economies



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