Lorig, F., Johansson, E. and Davidsson, P. (2021) 'Agent-Based Social Simulation of the Covid-19 Pandemic: A Systematic Review' Journal of Artificial Societies and Social Simulation 24 (3) 5: <http://jasss.soc.surrey.ac.uk/24/3/5.html>. doi: 10.18564/jasss.4601

Appendix

I) Attributes for analyzing Covid-19 simulation models (codebook)

Article: The study includes only simulation models for which a (scientific) article has been published or made available. Criteria for the systematic review (identification of articles in online literature databases) as well as for the inclusion and exclusion of articles were applied.

ID	Name	Description	Coding
1_1	Authors	The full names of the authors in the order of the authorship	Free text
1_2	Date Published	When the latest version of the article was published. Only articles that were published before October 1st are considered. For each preprint, we checked whether a peer-reviewed publication exists. These publications were then included in the review instead of the preprint. This applied even when the publication date was after October 1st as long as the preprint was uploaded before.	For articles that were uploaded to open-access archives (e.g. arxiv.org or medrxiv.org) the upload date of the latest version is provided (no later than December 1st, 2020). For articles that were uploaded to an online archive and published with peer-reviewed afterwards (e.g., journal publication) the date of the peer-reviewed publication is given.
1_3	Peer-reviewed	Whether the publication has been peer-reviewed prior to publication.	x: article has been peer-reviewed *no marking*: article has not been peer-reviewed

Purpose: Simulation of temporal spread of the virus under specific conditions. What the model has been used for in the article or what the authors claim the model can be used for.

ID	Name	Description	Coding
2_1	NPI Introduction	The model can be used to simulate how the introduction of NPIs affects the dynamics of the disease spread or pandemic.	x: model supports simulation of NPI introduction *no marking*: model does not support simulation of NPI introduction
2_2	NPI Adaptive Management	The model can be used to simulate how the adaptive	x: model supports simulation of NPI adaptive management

		management of NPIs affects the dynamics of the disease spread or pandemic. Adaptive management describes the dynamic introduction and removal of NPIs depending on specific indicators.	*no marking*: model does not support simulation of NPI adaptive management
2_3	NPI Removal	The model can be used to simulate how the removal of NPIs (exit strategies) affects the dynamics of the disease spread or pandemic.	x: model supports simulation of NPI removal (exit strategies) *no marking*: model does not support simulation of NPI removal (exit strategies)
2_4	PI Introduction	The model can be used to simulate how the introduction of PIs affects the dynamics of the disease spread or pandemic.	x: model supports simulation of PI introduction *no marking*: model does not support simulation of PI introduction
2_5	PI Adaptive Management	The model can be used to simulate how the adaptive management of PIs affects the dynamics of the disease spread or pandemic. Adaptive management describes the dynamic introduction and removal of PIs depending on specific indicators.	x: model supports simulation of PI adaptive management *no marking*: model does not support simulation of PI adaptive management
2_6	PI Removal	The model can be used to simulate how the removal of PIs (exit strategies) affects the dynamics of the disease spread or pandemic.	x: model supports simulation of PI removal (exit strategies) *no marking*: model does not support simulation of PI removal (exit strategies)

Non-pharmaceutical interventions (NPI) and pharmaceutical interventions (PI): Interventions whose effects can be simulated with the model.

ID	**Name**	**Description**	**Coding**
3_1	Lockdown (NPI)	Requirement for all individuals to stay at a specific location (e.g., at home) with exceptions for certain activities, e.g., buying food, or for certain groups, e.g., essential workers.	+: Experiments show that the intervention can reduce the spread of the disease. o: Experiments do not show that the intervention affects the spread of the disease.

			-: Experiments show that the intervention negatively affects the spread of the disease. x: The intervention can be analyzed, however, no experiments were conducted.
3_2	Curfew (NPI)	Requirement for all individuals to stay at a specific location (e.g., at home) at a certain time of the day (e.g., during night between 0:00 and 6:00).	see 3_1
3_3	Limitation of public gatherings (NPI)	Limitation on how many people may meet at public gatherings or events (e.g., max. 50 individuals at public gatherings like sport events, concerts, entertainment).	see 3_1
3_4	Limitation of private gathering (NPI)	Limitations on how many people may meet in a private context (e.g., max 2 households in private gatherings at home, at ceremonies like weddings or funerals, or at celebrations).	see 3_1
3_5	Quarantine / Isolation (NPI)	Requirement for certain individuals or groups of individuals to stay at a specific location (e.g., those that are (potentially) infected or in a risk group stay at home).	see 3_1
3_6	Social / physical distancing (NPI)	Requirement to keep a certain distance from other individuals.	see 3_1
3_7	Face masks (NPI)	Requirement to wear protective equipment (e.g., face mask, face shield, or similar).	see 3_1
3_8	Closure of schools (NPI)	Closure of educational institutions for children, e.g., schools and preschools.	see 3_1
3_9	Closure of universities (NPI)	Closure of educational institutions for students, e.g., universities.	see 3_1
3_10	Closure of all workplaces (NPI)	Closure of all workplaces, with possible exception for essential workers. Individuals will not go to their workplaces.	see 3_1
3_11	Closure of offices (NPI)	Closure of all office workplaces. Individuals that can work from home will not go to their workplaces (home-office).	see 3_1

3_12	Closure of leisure (NPI)	Closure of non-essential / recreational facilities (e.g., gyms or theaters).	see 3_1
3_13	Closure of shopping (NPI)	Closure of (non-essential) shops	see 3_1
3_14	Mobility restrictions / travel bans (NPI)	Limitation of movement between regions, can be temporary.	see 3_1
3_15	Contact tracing (NPI)	Contacts of infected individuals are traced manually or by the use of an app.	see 3_1
3_16	Testing (NPI)	Individuals are tested for an infection and, for instance, isolated in case of an infection.	see 3_1
3_17	Vaccination (PI)	Individuals are given a vaccination that prevents infections. Must be applied before the infection occurs.	see 3_1
3_18	Treatment (PI)	Infected individuals are given treatment that cures the infection.	see 3_1

Input: Data that is used as input of the model, not counting global parameters (e.g., R_0 values). Real-world datasets that are used for generating a more realistic population of individuals, realistic environments, or realistic behavior.

ID	Name	Description	Coding
4_1	Census data	Socio-demographic data on a population of individuals that describes individual traits (e.g., age, gender, household).	x: Census data is used. *no marking*: No census data is used.
4_2	Mobility data	Data on movement patterns or habits of individuals (e.g., cellphone data or travel data).	x: Mobility data is used. *no marking*: No mobility data is used.
4_3	GIS data	Spatial data of an area that is used for representing for instance distances or buildings (e.g., land register data or street networks)	x: GIS data is used. *no marking*: No GIS data is used.

Output: Performance measures that are used in the article and analyses that are provided, which can be used for assessing the dynamics of the virus spread.

ID	Name	Description	Coding
5_1	#infections	Number of individuals that have been infected (number of cases).	x: The number of infected individuals is provided.

			no marking: The number of infected individuals is not provided.
5_2	#deaths	Number of deceased individuals.	x: The number of deceased individuals is provided. *no marking*: The number of deceased individuals is not provided.
5_3	#hospitalized	Number of individuals that require medical care due to an infection.	x: The number of hospitalized individuals is provided. *no marking*: The number of hospitalized individuals is not provided.
5_4	Infection chains	It can be reconstructed how the infection has been passed between individuals.	x: Infection chains can be analyzed. *no marking*: Infection chains cannot be analyzed
5_5	Economic effects	The economic consequences of the pandemic can be investigated (e.g., loss of earnings due to lockdown).	x: Economic effects can be analyzed. *no marking*: Economic effects cannot be analyzed.

Transmission model: Factors which affect the transmission probability between individuals and that are used to determine whether or not an infection event will occur.

ID	Name	Description	Coding
6_1	Progress of disease: state	An individual's current state of the disease affects the likelihood to infect others (e.g., symptomatic individuals are more likely to infect others than asymptomatic individuals).	x: The disease state affects the individual likelihood of being infected. *no marking*: The disease state does not affect the individual likelihood of being infected.
6_2	Progress of disease: time since infection	The period of time since the infection has occurred affects the likelihood to infect others (e.g., an individual that has been infected 2 days ago is less contagious than an individual that has been infected 4 days ago).	x: The time since infection affects the individual likelihood of being infected. *no marking*: The time since infection does not affect the individual likelihood of being infected.
6_3	Age or age group	The age or age group of an individual has an effect on the likelihood of being infected (e.g., elderly people are more likely to	x: The age or age group affects the individual likelihood of being infected.

		be infected under identical circumstances compared to children).	*no marking*: The age or age group does not affect the individual likelihood of being infected.
6_4	Location	The likelihood of being infected depends on the current location (e.g., an individual is more likely to be infected when meeting a person inside a building than outside a building).	x: The location of the contact affects the individual likelihood of being infected. *no marking*: The location of the contact does not affect the individual likelihood of being infected.
6_5	Distance	The distance between individuals affects the likelihood of being infected (e.g., when standing 1m apart, the risk of being infected is greater compared to 2m).	x: The distance between individuals affects the individual likelihood of being infected. *no marking*: The distance between individuals does not affect the individual likelihood of being infected.
6_6	Density	The number of (infected) people in relation to the space affects the likelihood of being infected (e.g., when 5 people are present on 20m^2 the likelihood of being infected is greater compared to only 2 people being present on 20m^2).	x: The density affects the individual likelihood of being infected. *no marking*: The density does not affect the individual likelihood of being infected.
6_7	Contact or exposure time	The time individuals spend together or have contact affects the likelihood of being infected (e.g., contacts under 15min are riskless).	x: The contact time affects the individual likelihood of being infected. *no marking*: The contact time does not affect the individual likelihood of being infected.
6_8	Protection	The fact that an individual is wearing protective equipment affects the likelihood of being infected (e.g., those wearing face masks are less likely to be infected under similar conditions).	x: The wearing of protective equipment affects the individual likelihood of being infected. *no marking*: The wearing of protective equipment does not affect the individual likelihood of being infected.
6_9	Other	Other factors that affect the likelihood of being infected (e.g., pathogen level or aerosols in air).	Free text: What other factor affects the individual likelihood of being infected.

Attributes of individuals: Traits that are used to describe an individual. It is not considered whether these attributes affect the outcome of the simulation in terms of transmission likelihood or behavior.

ID	Name	Description	Coding
7_1	Age or age group	Age of individual or to what age group he or she belongs (e.g., 15 years or group "children").	x: Each individual is assigned an age or age group. *no marking*: Individuals are not assigned an age or age group.
7_2	Gender	Gender of individual (e.g., female or male).	x: Each individual is assigned a gender. *no marking*: Individuals are not assigned a gender
7_3	Workplace	Individuals are assigned to a specific workplace and/or workplace contacts.	x: Each individual is assigned a workplace. *no marking*: Individuals are not assigned a workplace.
7_4	Profession	The type of work an individual performs and that, for instance, determines whether this individual is qualified for home-office (e.g., essential workers or those who can work from home).	x: Each individual is assigned a profession. *no marking*: Individuals are not assigned a profession.
7_5	Household	Individuals live together with others (e.g., family or shared apartment).	x: Each individual is assigned a household. *no marking*: Individuals are not assigned a household.
7_6	Location	Individual is capable of moving between locations or points and is at any point in time at a specific location (e.g., from home to work to shopping). A location is either abstract, e.g. "home", or specified using geographical coordinates.	x: Each individual is assigned a current location. *no marking*: Individuals are not assigned a current location.
7_7	Contacts	A network of other individuals which a specific individual is in contact with.	x: Each individual is assigned a contact network. *no marking*: Individuals are not assigned a contact network.
7_8	Contact rate	A factor indicating the (average) number of contacts an individual has in a given period of time (e.g., 5 encounters per day).	x: Each individual is assigned a contact rate. *no marking*: Individuals are not assigned a contact rate.

7_9	Protection	Individuals can wear wearing protective equipment against the virus (e.g., face masks).	x: Each individual has an individual status of wearing protective equipment. *no marking*: Individuals do not have an individual status of wearing protective equipment.
7_10	Health status	Risk factors, which makes an individual (compared to others) more prone to being infected (e.g., due to a weak immune system or a disability) or which results in more severe infections (e.g., due to obesity).	x: Each individual is assigned a health status. *no marking*: Individuals are not assigned a health status.
7_11	Other	Other traits or attributes that are different between individuals (e.g., owning a car).	Free text.

Disease states: Different states that are used for describing the presence, progress, treatment, or outcome of an infection.

ID	**Name**	**Description**	**Coding**
8_1	Susceptible	The individual is neither infected nor has any immunity against the virus.	x: There are susceptible individuals in the model. *no marking*: There are no susceptible individuals in the model.
8_2	Exposed	The individual has been infected but is not infectious (incubation period).	x: There are exposed individuals in the model. *no marking*: There are no exposed individuals in the model.
8_3	Infected	The individual has been infected and is infectious without any specification of symptoms. (This attribute can be further specified by 8_4 and 8_5.)	x: There are infected individuals in the model. *no marking*: There are no infected individuals in the model.
8_4	Infected without symptoms	The individual has been infected, is infectious, and does not show symptoms (asymptomatic). (This attribute further specifies 8_3.)	x: There are infected individuals with symptoms in the model. *no marking*: There are no infected individuals with symptoms in the model.
8_5	Infected with symptoms	The individual has been infected, is infectious, and shows symptoms. (This attribute further specifies 8_3.)	x: There are infected individuals without symptoms in the model.

			no marking: There are no infected individuals without symptoms in the model.
8_6	Severely ill	The individual needs to be hospitalized.	x: There are severely ill individuals in the model that require treatment in a hospital. *no marking*: There are no severely ill individuals in the model that require treatment in a hospital.
8_7	Critically ill	The individual needs ICU care / ventilator.	x: There are critically ill individuals in the model that require ICU treatment. *no marking*: There are no critically ill individuals in the model that require ICU treatment.
8_8	Dead	The individual has been infected and did not recover.	x: Individuals can die due to an infection. *no marking*: Individuals cannot die due to an infection
8_9	Recovered	The individual has been infected, has recovered, and is now immune.	x: Individuals can recover from an infection. *no marking*: Individuals cannot recover from an infection.

Model characteristics: Attributes that describe the simulation model.

ID	**Name**	**Description**	**Coding**
9_1	Name of the model	How the authors refer to the model.	Free text
9_2	Number of individuals	The largest number of individuals that was simulated in the article. (If no experiments were conducted, the number of individuals that can be simulated according to the authors.)	Number
9_3	Region	The region(s), cities, or countries used in the article to demonstrate the model.	Free text
9_4	Framework	The simulation framework or programming language that has been used to build the model.	Free text
9_5	Accessibility	The model is freely available and can be accessed or downloaded.	Free text
9_6	Agent behavior	A description of how the behavior of the individuals is modelled. How do they decide	1. Random (no social network, no spatial network)

		what actions to perform in a particular situation?	2. Random (spatial network but no social network) 3. Random (social network but no spatial network) 4. Random (Social and spatial network) 5. Fixed behavior (e.g., schedule, behavioral patterns) 6. Dynamic or adaptive behavior (e.g., based on needs or utility) *no marking*: Not described
9_7	Validation	How was the model validated? What approaches were applied to validate the model and against what data was the model validated?	1. Real-world data (e.g., reports, surveys, epidemic factors) 2. Comparison with other models 3. Systematic testing (e.g., test cases) 4. Assessment of conclusions 5. Validation of soundness by experts *no marking*: Not described / not conducted
9_8	Calibration	Was the model calibrated? Due to the heterogeneity of approaches for calibrating simulation models, we only analyzed whether the calibration of the model was presented or discussed in the article.	x: the calibration of the model was mentioned in the article; it was described what parameter was calibrated or what methods were used *no marking*: Not described / not conducted

II) Analysis of included simulation models

For resolving the article IDs, please refer to the reference list provided in part III of this Appendix.

II-1) Article and model settings

Article			Model settings				
Article ID	**Date published**	**Peer-reviewed**	**Name of the model**	**Nr. of individuals**	**Region**	**Framework**	**Accessible**
1	2020-07-24	x		10 000	Ontario, Canada	Julia	x
2	2020-07-30			2 500	Kuwait		
3	2020-04-12			10 000	Hubei, China; South Korea; Iran; Spain		
4	2020-06-09				USA		x
5	2020-06-09		COVAM		Dane Country, Milwaukee, NYC, USA		
6	2020-08-05	x		85 000	Boston, USA	R	
7	2020-07-27			103 000	Glasgow, UK		
8	2020-05-28				UK		On request
9	2020-08-19			1 000 000	New York, USA		
10	2020-08-21			2000	USA		
11	2020-04-22				Ontario, Canada	TreeAge Pro	
12	2020-11-08	x		472 319	Bengaluru, India		
13	2020-09-17			9 000 000	Austria	ABT/Java	
14	2020-07-01						
15	2020-03-06				China		
16	2020-06-04	x		4 000		R	x
17	2020-04-12		Episim	114 346	Nelson Mandela Bay Municipality, South Africa	MATSim, EpiSim	
18	2020-06-04	x		250	Italy; China	C++	
19	2020-09-10	x		500		Netlogo	
20	2020-05-01						x
21	2020-06-24					NetLogo	
22	2020-07-02					?	
23	2020-11-11	x	ACEMod	24 000 000	Australia	AceMod (C++)	
24	2020-08-12				Taiwan		
25	2020-04-11		Corvid	563 484	Seattle, USA	FLuTE (C++), R	

26	2020-09-18	x	COVOID	100 000	Sydney, Australia	R, EpiModel	
27	2020-07-25				Belgium		
28	2020-10-31	x		1 000			x
29	2020-05-20	x		1000	Indoors		
30	2020-09-25			1 150	University Buildings		
31	2020-07-29		SABCoM	100 000	Cape Town, South Africa	Python	x
32	2020-06-15	x	ASSOCC	2 500		NetLogo	x
33	2020-10-07				Denmark		
34	2020-09-02			45 000	Illinois, USA		
35	2020-09-14			6 732 000	Indiana, USA	FRED	
36	2020-02-25			354	Diamond Princess		
37	2020-03-16				UK; USA		
38	2020-06-07			100 000			
39	2020-08-07	x		470	Haslemere, UK		x
40	2020-04-15			10 090 000	Sweden		x
41	2020-05-18				Slovakia		x
42	2020-09-24	x	COMOKIT	10 600	Son Loi, Vietnam	GAMA	
43	2020-04-18			20 000	Germany	?	
44	2020-09-13			10 000 000	Lombardy, Italy	MATLAB	x
45	2020-05-27		GERDA	10 000	Gangelt+Heinsberg, Germany; UK; Sweden	Python	x
46	2020-04-22		INFEKTA	1001	Bogotá, Colombia	AnyLogic	x
47	2020-04-24			100 000	Bengaluru, India	Python	
48	2020-06-28			55 000			
49	2020-08-03	x		2000	Campuses		
50	2020-05-06			1 000			
51	2020-08-07			1000	San Francisco		
52	2020-02-28	x			Singapore; Wuhan, China	R	
53	2020-06-07		CRISP	10 000		Python/C++	x
54	2020-05-27	x		1 000 000			
55	2020-10-12	x		10 000		Python	
56	2020-09-22		OpenABM-Covid19		UK		x
57	2020-04-28			500 000	New York City, USA	C++, SAS	github
58	2020-08-25				Hospitals		x
59	2020-09-22	x	HSEM	509 000	King County, USA	GAMA	x
60	2020-06-26		CoV-ABM	1 000 000	Delaware, USA	Python	
61	2020-09-01			3 700	Diamond Princess	EpiModel	
62	2020-04-21			200	UK		x

63	2020-07-24			1 000			
64	2020-10-29	x		10 000			
65	2020-09-29	x			Ontario, Canada		
66	2020-04-28			10 000			
67	2020-04-15			100			
68	2020-05-15		Covasim	200 000		Python	
69	2020-04-26	x		35 000	Copacabana, Brasil	AnyLogic	
70	2020-07-13			10 000			
71	2020-03-23	x	GeoDEMOS-R, FLuTE		Singapore		
72	2020-07-16	x			Netherlands		
73	2020-04-29	x		25 000	UK		x
74	2020-06-23	x		10 000			
75	2020-06-17	x			UK		x
76	2020-07-14						x
77	2020-08-28				Areas in Germany; Switzerland		
78	2020-07-30	x		750 000	Urmia, Iran	NetLogo	
79	2020-06-16			10 000			x
80	2020-08-20	x	FACS	330 795	London, UK	Python	
81	2020-04-02	x		5 000		NetLogo	
82	2020-09-29		EPISIM	84 110	Sioux Falls, South Dakota	Matsim, Episim	
83	2020-07-24			2000			
84	2020-05-28	x		2 000			
85	2020-09-08			6	Hospital bays		
86	2020-04-23	x		10 000			x
87	2020-04-06			500 000		R	
88	2020-03-23			272 409	Newcastle, Australia		
89	2020-05-27	x				Python	x
90	2020-03-30				Germany		
91	2020-09-22	x		10 000		C++, Python	
92	2020-06-05				China; Italy; Spain; USA	Python	x
93	2020-09-28			548 323	Telangana, India	AnyLogic	
94	2020-07-24	x	CEACOV	6 900 000	Massachusetts, USA		
95	2020-08-19				Taiwan		
96	2020-09-14	x		100 000	Canada	AnyLogic	
97	2020-08-05		Epidemology Workbench	132 000	Urbana + Champaign, USA	Python	

98	2020-05-20	x					
99	2020-10-14			4400	Piedmont, Italy	Netlogo	x
100	2020-08-16				Ontario, Canada		
101	2020-09-14			1 000 000			
102	2020-08-21			5 000		Netlogo	
103	2020-06-10			23 000	Cincinnati, USA	Python	
104	2020-05-05			10 000		Python	x
105	2020-07-09	x		24 000 000	Australia		
106	2020-09-29			1 017 720	North Carolina, USA		
107	2021-02-15	x	COmplexVID-19		Brazil		
108	2020-07-07	x	COVID-ABS	300	Brazil	Python	x
109	2020-07-29						
110	2020-06-08			2 100 000	Perth, Australia	Python	
111	2020-06-15	x		2 171 000	Daegu, South Korea		
112	2020-07-13		ABM-SEIR	25 000 000	Australa, New Zealand		x
113	2020-04-10			75 000			
114	2020-04-17		REINA	1 600 000	Finland	Python	x
115	2020-09-10	x		300 000	Kenya		x
116	2020-07-26	x	COVID-19 ABM	200 000	Salzburg, Austria	GAMA	
117	2020-03-27			2 000		NetLogo	x
118	2020-04-29			10 000			x
119	2020-09-10			700 000	Southwestern Wales, UK		x
120	2020-09-24	x		58 500 000	Hubei, China; Lombardy, Italy; New York City, USA		x
121	2020-07-06		STRIDE	11 000 000	Belgium	C++, R	
122	2020-06-18			8 000	Indoors		
123	2020-05-07	x		60 000 000	Wuhan, China; Toronto, Canada; Italy		
124	2020-06-12			10 000	Portland, USA		
125	2020-07-02	x		13 000 000	Shenzhen, China		
126	2020-03-27				Italy; USA		

II-2) Purpose of the simulation

	Purpose / (Temporal simulation of ...)					
	NPI			PI		
Article ID	Introducing	Adaptive management	Removing (exit)	Introducing	Adaptive management	Removing (exit)
1	x					
2	x					
3	x					
4	x		x			
5	x		x			
6			x			
7	x					
8	x					
9	x		x			
10	x		x			
11						
12	x	x				
13	x					
14						
15						
16	x					
17	x					
18	x					
19	x					
20	x					
21	x					
22	x					
23	x					
24	x					

25	x					
26	x					
27	x		x			
28			x			
29	x					
30	x					
31	x					
32	x	x	x			
33	x		x			
34	x					
35	x		x			
36	x					
37	x					
38	x					
39	x					
40	x					
41	x	x	x			
42	x					
43	x		x			
44	x			x		
45	x		x			
46	x					
47	x					
48				x		
49	x					
50	x					
51	x		x			
52	x					
53	x					
54	x					

55	x					
56	x					
57	x		x	x		
58	x					
59	x					
60	x					
61	x					
62	x					
63	x					
64	x	x	x			
65	x	x	x			
66	x		x			
67	x					
68	x			x		
69	x					
70	x	x				
71	x					
72	x					
73	x					
74	x					
75	x		x			
76						
77	x			x		
78	x					
79	x		x			
80	x					
81	x					
82						
83	x					
84	x					

85	x			x		
86	x			x		
87	x					
88	x					
89	x		x			
90	x					
91				x		
92	x		x			
93	x					
94	x					
95	x					
96	x					
97	x					
98	x					
99	x					
100	x					
101	x					
102	x					
103	x		x			
104	x		x			
105	x					
106	x					
107	x		x			
108	x					
109	x					
110	x					
111	x		x			
112	x		x			
113	x	x				
114	x					

115	x					
116		x	x			
117	x					
118	x					
119	x					
120	x					
121	x		x			
122	x					
123	x					
124	x					
125	x					
126	x					

II-3) Non-pharmaceutical interventions (NPI) and pharmaceutical interventions (PI)

Article	Non-pharmaceutical interventions (NPI) and pharmaceutical interventions (PI)																		
	NPI																PI		
			Limits on gatherings																
Article ID	Lockdown	Curfew	public gatherings	private gatherings	Quarantine/Isolation	Social/physical distancing	Face masks	Closure of schools	Closure of universities	Closure of all workplaces	Closure of offices	Close of leisure	Closure of shopping	Mobility redstrictions / travel bans	Tracing	Testing	Vaccination	Treatment	No intervention studied
1					+			o											
2	o																		
3					x	x										+			
4						+	+	+	+	+	+								
5						+													
6					+	+									+	+			
7															+				
8	+				+	+									+	+			
9	+							+		+									
10						+	+					-				+			
11																			x
12	x				+									+	+				
13					+										+				
14																			
15																			x

16						+													
17	+								+			+	+						
18	+					+													
19					+	+													
20	o				+											+			
21	+				+	+	+												
22					+										+				
23					+	+		o											
24														+					
25					x			x			x					x			
26						+													
27	o							o	o		o	o							
28					o														
29							+							+					
30							+												
31	+					+								+					
32						+		-	-	-					o	+			
33	+				+	+									+	+			
34					+										+	+			
35						+	+												
36						+	+												
37					+	+		+	+										
38					o										o	o			
39					+	+									+	+			
40					+	+		+	+			+							
41	-				+	+								+					
42	+				+		o							+		+			
43	+				+											+			
44	+																+		
45	+					o	o	+											

46						+													
47	x				x										x	+			
48																	+		
49					+	+									+	+			
50				+															
51						+		+	+	+									
52					+										+				
53					+										+	+			
54					+										+				
55					+	+											+		
56	o				o	o									o	o			
57					o											+	+		
58					+	+	+												
59					+	+					+					+			
60					+														
61	+				+		o									+			
62							+												
63	o																		
64	+					o									+	+			
65								x	x	x									
66	+																		
67	o																		
68					x	x									x	x	x	x	
69					+	+													
70	o														+	+			
71					+			+			+								
72					x										+	+			
73			x	x	+										+	+			
74					+										+	+			
75																			x

76																			x
77	+	+				o				o					o	+			
78						+		+			+								
79	+																		
80	x							x			x	x	x						
81		o																	
82																			x
83																			x
84	o																		
85																+			
86						+										+			
87															+	+			
88					+	+		+			+								
89				+		+													
90	+							-		-	-	-							
91																	+		
92						o		o											
93	+					+													
94																+			
95					+	+	+								+	+			
96					+	+		o	o	+					+	+			
97					+	+	+								+	+			
98					+	+									+				
99	+				+	+		+		+				+					
100																			x
101					+	+									+	+			
102														+	+	+			
103					+					+									
104					+	o									+	+			
105																+			

106							+												
107	+					+				+									
108	+				o		+												
109	+					+	o					+							
110					+														
111								+											
112						+													
113					+	+													
114					+									o	+	+			
115			+	+		+		o							+				
116	+														o				
117					+		+								x				
118																			x
119	o				+										+	+			
120					+	+													
121					+	+		o							+	+			
122			+		o								-						
123	+				+	+	+								+				
124						+													
125					+		+	+		+						+			
126					+	+													

II-4) Inputs and Outputs

Article	Inputs			Outputs					
Article ID	Census data	Mobility data	GIS data	#infections	#deaths	#hospitalized	#contacts	Infection chains	Economic effects
1	x			x					
2				x					
3				x					
4	x	x		x	x	x			x
5		x		x	x	x			
6	x	x		x		x			
7	x			x					
8	x	x		x					
9	x	x		x					
10				x					
11				x	x	x			
12	?	?		x	x				
13	x			x					
14				x	x				
15				x					
16				x					
17	x	x		x		x			
18				x	x	x	x		
19				x					
20	x			x	x	x			x
21				x					
22		x		x					
23	x	x		x					
24		x	x	x					
25	x	x							
26				x	x	x			
27		x				x			
28				x					
29				x					
30				x					

31	x	x	x	x	x				
32	x			x	x	x		x	x
33				x					
34				x	x	x			
35	x		x	x	x	x		x	
36				x					
37	x			x	x	x			
38			x	x					
39	x	x		x				x	
40	x			x	x	x			
41	x	x		x	x	x			
42	x		x	x	x				
43				x	x	x			
44				x	x				
45	x		x	x	x		x	x	
46				x	x	x			
47	x	x		x					
48				x	x				
49				x					
50				x					
51	x			x	x	x			
52				x					
53				x					
54		x		x					
55				x					
56	x			x	x	x		x	
57	x			x	x	x			
58				x				x	x
59		x		x		x			x
60	x		x	x	x				
61	x			x					
62				x					
63				x	x				x
64				x	x				x
65	x	x		x					
66				x					x
67				x					

68	x			x	x	x			
69	x			x	x	x			
70				x	x				x
71	x		x	x					
72				x					
73	x								
74				x					
75	x				x				
76				x	x	x			
77		x		x	x	x			
78	x		x	x	x				
79	x			x	x				
80	x		x	x	x	x	x		
81				x					
82	x		x	x		x			
83				x					
84				x					
85				x					
86	x			x	x	x			
87				x	x	x			
88	x	x		x					
89				x	x	x		x	
90		x		x					
91				x					
92	x			x	x	x			
93	x			x	x	x			
94				x	x	x			x
95				x					
96	x	x		x	x	x			
97	x	x		x	x	x			
98									
99				x	x			x	
100	x			x					
101				x					
102				x					
103	x		x	x					
104				x					

105	x			x					
106	x			x		x			
107	x			x	x	x			
108	x	x		x	x	x			x
109				x	x				
110				x					
111	x			x		x			
112	x			x					
113		x		x					
114	x	x							
115	x	x		x					
116		x		x					
117				x					x
118				x					
119	x			x					
120	x			x	x				
121	x			x		x			
122		x							
123				x					
124	x			x					
125	x	x	x	x					
126				x					

II-5) Transmission model input

Article ID	State	Time since infection	Age	Location / place	Distance	Density	Contact time	Protection
1			x					
2					x			
3						x		
4				x				
5	x							
6	x							
7			x	x				
8			x	x				
9	x							
10				x	x	x	x	
11								
12	x							
13								
14								
15					x			
16								
17	x				x	x	x	
18					x			x
19				x				
20			x			x		
21					x			x
22	x	x					x	
23	x		x	x				
24				x		x		
25		x	x					

26	x			x				
27								
28	x							
29								
30		x					x	x
31	x							
32			x	x		x		
33								
34								
35			x	x				
36		x			x			x
37	x	x		x	x	x		
38								
39	x	x						
40	x	x		x				
41						x		
42				x	x			
43				x				
44					x			
45		x	x	x				x
46					x			
47				x				
48	x				x			
49		x						
50								
51	x		x					
52								
53								
54								
55		x						

56	x	x	x	x				
57	x	x	x		x	x		
58	x							x
59				x				
60	x			x				
61								
62								x
63								
64						x		
65	x			x				
66							x	
67								
68	x	x	x					
69	x							
70								
71				x				
72								
73				x				
74								
75			x					
76								
77	x			x			x	
78	x			x	x	x		
79	x							
80				x	x	x	x	
81								
82	x		x				x	x
83								
84								
85					x			x

86		x						
87								
88								
89								
90						x		
91						x		
92								
93	x		x		x	x		
94								
95								
96								
97			x	x		x	x	
98		x						
99					x			
100			x	x				
101		x						
102								
103				x				
104								
105	x	x	x					
106	x							
107							x	
108		x			x	x		
109					x			
110								
111		x		x				
112	x	x		x				x
113								
114		x						
115	x		x					

116	x	x		x				
117					x			x
118								
119	x			x				
120			x	x				
121			x	x				
122					x	x		
123	x							x
124								
125				x				x
126								

II-6) Attributes of individuals

Article ID	Age / age group	Gender / Sex	Work-place	Profession	Household	Location	Contacts	Contact rate / probability	Pro-tection	Health status
1	x						x			
2						x				
3										
4	x		x	x	x		x			x
5	x							x		
6	x		x		x	x	x			
7	x		x		x					
8			x		x					
9	x		x		x					
10										
11										
12							x			
13	x	x	x		x	x				
14						x				
15							x			
16	x		x		x	x				
17			x		x	x	x			
18	x					x				x
19										
20	x									
21										
22							x			
23	x	x	x			x	x	x		x
24						x				
25	x		x		x					
26							x			
27	x									
28							x			
29							x			
30						x			x	
31	x				x		x			
32	x		x		x	x	x			

33			x		x		x			
34										
35	x		x		x	x	x			
36						x				
37	x		x		x	x				
38						x				x
39							x			
40	x		x		x					
41	x				x			x		
42	x	x	x		x	x	x	x		
43			x	x	x	x	x			
44										
45	x		x		x	x				
46	x	x	x		x	x				x
47						x	x	x		
48										
49							x			
50							x			
51	x		x	x	x			x		
52										
53							x			
54							x			
55							x			
56	x		x		x		x			
57	x	x			x		x	x		x
58										x
59	x	x	x		x	x				
60	x		x		x	x	x			x
61	x			x						
62								x	x	
63				x	x	x				
64										
65			x			x	x			
66			x		x					
67						x				
68	x	x	x		x	x	x			
69	x		x		x			x		x

70							x			
71	x	x	x	x	x	x				
72					x			x		
73	x		x		x		x			
74							x			
75	x				x					
76						x				
77	x		x		x		x			
78	x	x	x	x	x	x				x
79				x	x		x			
80	x		x			x				
81						x				
82	x		x							
83	x				x		x	x		
84							x			
85						?	?		?	
86							x			x
87										
88	x		x		x					
89										
90						x				
91						x				
92	x		x		x		x			
93	x						x	x		
94	x									
95										
96	x		x		x	x				
97	x	x								
98										
99			x		x	x				
100	x				x	x				
101							x			
102										
103	x	x	x		x	x	x			
104								x		
105					x		x			
106	x		x		x		x			

107	x		x		x	x	x			
108	x		x		x	x				
109						x	x		x	
110								x		
111	x		x		x		x			
112	x		x	x	x	x				x
113							x			
114	x							x		
115	x				x		x			
116						x				
117						x				
118						x				x
119										
120	x				x					x
121	x		x		x	x	x			
122										
123								x		
124							x			
125	x		x		x	x				
126										

II-7) Disease states

	Disease states								
Article ID	susceptible	exposed	infected	infected with symptoms	infected without symptoms	severely ill	critically ill	dead	recovered
1	x	x	x	x	x	x	x	x	x
2	x		x	x	x				
3	x		x						x
4	x	x	x	x	x	x	x	x	x
5	x	x	x			x	x	x	x
6	x	x	x	x	x	x	x		x
7	x	x	x	x	x	x		x	x
8			x						
9	x	x	x	x	x				x
10	x	x	x	x	x				x
11	x		x			x	x	x	x
12	x	x	x			x	x	x	x
13	x	x	x						x
14	x		x	x	x			x	x
15	x		x						x
16	x	x	x						x
17	x		x						x
18	x	x	x			x		x	x
19	x	x	x	x	x			x	x
20	x		x				x		x
21	x	x	x						x
22	x		x	x	x				
23	x	x	x	x	x				x
24	x	x	x						x
25	x	x	x	x	x				x
26	x		x	x	x	x		x	x
27	x	x	x	x	x	x		x	x
28	x	x	x			x			x
29	x		x						x
30	x		x	x	x				
31	x	x	x	x	x		x	x	x

32	x		x	x	x			x	x
33	x	x	x						x
34	x		x			x	x	x	
35	x	x	x						x
36	x		x						
37	x	x	x	x	x	x	x	x	x
38	x	x	x	x	x	x	x	x	x
39	x	x	x	x	x				x
40	x		x			x	x	x	x
41	x	x	x	x	x	x	x	x	x
42	x	x	x	x	x	x	x	x	x
43	x	x	x			x	x	x	x
44	x		x					x	x
45	x		x			x	x	x	x
46	x	x	x			x	x	x	x
47	x	x	x						x
48	x		x					x	x
49	x		x						x
50	x		x						x
51	x	x	x	x	x	x		x	x
52			x	x	x				
53	x	x	x						x
54	x		x						x
55	x		x						x
56	x	x	x	x	x	x	x	x	x
57	x	x	x	x	x	x	x	x	x
58	x	x	x			x			x
59	x	x	x						x
60	x	x	x	x	x	x		x	x
61	x	x	x	x	x				x
62	x	x	x					x	x
63	x	x	x					x	x
64	x		x					x	x
65	x	x	x	x	x				x
66	x	x	x						x
67	x		x						
68	x	x	x	x	x	x	x	x	x

69	x		x	x	x	x			x
70	x	x	x	x	x				x
71	x		x	x	x				x
72	x	x	x	x	x				x
73	x		x	x	x				
74	x		x						x
75	x		x						
76	x	x	x					x	x
77	x	x	x	x	x	x		x	x
78	x	x	x					x	x
79	x		x	x	x			x	x
80	x	x	x			x		x	x
81	x		x						
82	x	x	x	x	x	x	x		x
83	x	x	x						x
84	x	x	x						x
85	x	x	x						x
86	x	x	x	x	x	x		x	x
87	x		x	x	x	x		x	x
88	x	x	x	x	x				x
89	x	x	x						x
90	x		x						x
91	x		x						x
92	x	x	x			x	x	x	x
93	x		x	x	x		x	x	x
94	x	x	x	x	x	x	x		x
95			x						
96	x	x	x	x	x	x	x	x	x
97	x	x	x	x	x	x		x	x
98	x	x	x						x
99	x		x	x	x				x
100	x	x	x	x	x				x
101	x	x	x						x
102	x	x	x						x
103	x		x	x	x				x
104	x	x	x						x
105	x		x	x	x				

106	x	x	x	x	x	x		x	x
107	x		x	x	x	x	x	x	x
108	x	x	x	x	x	x	x	x	x
109	x		x					x	x
110	x	x	x						x
111	x	x	x			x			x
112	x	x	x						x
113	x	x	x					x	x
114	x	x	x			x	x	x	x
115	x	x	x	x	x				
116	x		x	x	x				x
117	x	x	x						x
118	x	x	x						x
119	x	x	x	x	x				x
120	x	x	x	x	x	x	x	x	x
121	x	x	x	x	x				x
122	x		x						
123	x	x	x	x	x	x		x	x
124	x	x	x	x	x				x
125	x	x	x	x	x				x
126	x		x						

II-8) Agent behavior, validation, and calibration

Article ID	Agent Behavior	Validation	Calibration
1	random (social network but no spatial network)		x
2	random (spatial network but no social network)		
3	random (spatial network but no social network)		
4	random (social network but no spatial network)		x
5	random (no social network, no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
6	random (social and spatial network)		x
7	random (social network but no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
8	random (social and spatial network)		x
9	random (social and spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
10	fixed behavior (e.g., schedule or behavioral patterns)		
11	dynamic or adaptive behavior (e.g., based on needs or utility)	real-world data (e.g., reports, survey data, or epidemic factor)	x
12	random (spatial network but no social network)		x
13	random (social and spatial network)		x
14	random (spatial network but no social network)		x
15	random (spatial network but no social network)		
16	random (social network but no spatial network)		x
17	random (social network but no spatial network)		x
18	random (spatial network but no social network)		
19	random (social network but no spatial network)		
20	dynamic or adaptive behavior (e.g., based on needs or utility)		x
21	random (spatial network but no social network)		
22	random (social network but no spatial network)		x
23	fixed behavior (e.g., schedule or behavioral patterns)		x
24	random (no social network, no spatial network)		
25			x

26	random (no social network, no spatial network)		
27	random (social network but no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
28			
29	random (spatial network but no social network)		
30	random (social network but no spatial network)	comparison with other models	x
31	dynamic or adaptive behavior (e.g., based on needs or utility)		x
32	random (spatial network but no social network)		x
33	random (social network but no spatial network)		x
34			
35	random (social network but no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
36			
37	random (social and spatial network)		x
38			
39	random (social network but no spatial network)		
40	random (social network but no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
41	random (social and spatial network)		
42	fixed behavior (e.g., schedule or behavioral patterns)		x
43	random (no social network, no spatial network)		x
44	random (spatial network but no social network)		
45	random (spatial network but no social network)		
46			
47	fixed behavior (e.g., schedule or behavioral patterns)		
48	random (social and spatial network)		
49	random (spatial network but no social network)		
50	fixed behavior (e.g., schedule or behavioral patterns)	real-world data (e.g., reports, survey data, or epidemic factor)	x
51	random (social network but no spatial network)		x
52	random (social network but no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	
53	random (no social network, no spatial network)		
54	random (no social network, no spatial network)		
55	random (social network but no spatial network)		

56	random (social network but no spatial network)		
57	random (social network but no spatial network)	systematic testing (e.g., test cases or sensitivity analysis)	
58	random (social and spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
59	random (no social network, no spatial network)		x
60	fixed behavior (e.g., schedule or behavioral patterns)	real-world data (e.g., reports, survey data, or epidemic factor)	x
61	dynamic or adaptive behavior (e.g., based on needs or utility)		
62	random (social network but no spatial network)		x
63	random (spatial network but no social network) + random (social network but no spatial network)	assessment of conclusions	
64	dynamic or adaptive behavior (e.g., based on needs or utility)		
65	dynamic or adaptive behavior (e.g., based on needs or utility)		x
66	random (spatial network but no social network)		x
67	random (social network but no spatial network)		
68	random (spatial network but no social network)		
69	random (social network but no spatial network)		x
70	fixed behavior (e.g., schedule or behavioral patterns)		
71	random (social network but no spatial network)		
72	random (social network but no spatial network)		x
73	random (no social network, no spatial network)		x
74	random (social network but no spatial network)		
75	random (social network but no spatial network)		
76	random (social network but no spatial network)		x
77	random (spatial network but no social network)		
78	fixed behavior (e.g., schedule or behavioral patterns)	real-world data (e.g., reports, survey data, or epidemic factor)	x
79	random (social network but no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	
80	fixed behavior (e.g., schedule or behavioral patterns)	validation of soundness by experts	
81	fixed behavior (e.g., schedule or behavioral patterns)		
82			
83	random (social network but no spatial network)		
84	random (social network but no spatial network)		
85	random (social network but no spatial network)		

86	random (social network but no spatial network)		
87	random (no social network, no spatial network)		
88	fixed behavior (e.g., schedule or behavioral patterns)		x
89	random (no social network, no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	
90	random (social and spatial network)		x
91		real-world data (e.g., reports, survey data, or epidemic factor)	
92	random (social network but no spatial network)		
93	random (social network but no spatial network)		
94	random (no social network, no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
95	random (no social network, no spatial network)		x
96			x
97	random (spatial network but no social network)		
98	random (no social network, no spatial network)		x
99	fixed behavior (e.g., schedule or behavioral patterns)		
100	random (social network but no spatial network)		x
101	random (no social network, no spatial network) + random (social network but no spatial network)	comparison with other models	x
102	random (no social network, no spatial network)		
103	fixed behavior (e.g., schedule or behavioral patterns)		
104	random (social network but no spatial network)		x
105	fixed behavior (e.g., schedule or behavioral patterns)	real-world data (e.g., reports, survey data, or epidemic factor)	x
106	random (social network but no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
107	random (social network but no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	
108	fixed behavior (e.g., schedule or behavioral patterns)		
109	random (spatial network but no social network)		
110	random (social network but no spatial network)		x
111	random (social network but no spatial network)		
112	random (spatial network but no social network)	comparison with other models	x
113	random (social network but no spatial network)	comparison with other models	
114	random (no social network, no spatial network)	systematic testing (e.g., test cases or sensitivity analysis)	

115	random (no social network, no spatial network)		
116	fixed behavior (e.g., schedule or behavioral patterns)	validation of soundness by experts	x
117	random (spatial network but no social network)	systematic testing (e.g., test cases or sensitivity analysis)	
118	random (social network but no spatial network)		
119	random (no social network, no spatial network)		
120	random (no social network, no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	x
121	random (social network but no spatial network)		x
122	random (spatial network but no social network)		
123	random (social network but no spatial network)		x
124	random (social network but no spatial network)		x
125	fixed behavior (e.g., schedule or behavioral patterns)		
126	random (social network but no spatial network)	real-world data (e.g., reports, survey data, or epidemic factor)	

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