Supplementary material

Table S1. A summary of the variation in published reports of key biological, clinical and epidemiological characteristics for SARS-CoV-2 (as of 2nd Aug 2020) and four of the alternative 'model organisms' used to offer insight and foresight at the beginning of the COVID-19 pandemic: SARS-CoV-1 (SARS); MERS-CoV (MERS); A/H1N1pdm09 (swine flu); and A/H3N2 (as an example of 'seasonal influenza').

	Disease:	**COVID-19**	**Model organism**			
Characteristics and parameters:	**Pathogen:** **Status:**	**SARS-CoV-2** 2019-ongoing	**SARS-CoV-1** 2002-04	**MERS-CoV** 2012-ongoing	**A/H1N1pdm09** 2009-10 (swine flu)	**A/H3N2** Seasonal influenza
R_0[1] (mean, if available; range)		2.6 (mean); 1.4-6.5	2.0-3.0	0.9-1.5	1.2-2.8	0.9-2.2
Incubation period[2] (mean; range)		5.1 (2-14) days	4.6 (2-14) days	5.2 (2.0-13.0) days	2.0 (1.0-7.0) days	1.0 (0.5-3.0) days
Serial interval[3] (mean; range, if available)		2.6-8.0 days	8.4 days	7.6 (3.0-19.4) days	2.8 (1.7-7.0) days	3.3 (2.1-3.5) days
Duration – symptom onset to death (median or mean; range, if available)		14 days (median) (range: 6-41 days)	23.7 days (mean) (range: 10-24 days)	12 days (median) (range: 5-23 days)	14.7 days (mean) (range: 8-25 days)	13.4 days (mean) (range: 6-26 days)
Total cases (cumulative/annual)		>17million[4]	8,098 (to 2004)	2,519 (to Jan 2020)	c800-1,600million	c3.6-65million·yr^{-1}
Total deaths (cumulative/annual)		>670,000[4]	774 (to 2004)	866 (to Jan 2020)	c151,700-575,500	290-650,000·yr^{-1}
Overall *CFR*[5]		2-15%	5-15%	20-36%	0.01-0.12%	0.01-0.33%
CFR[5] amongst hospitalised cases		28-62%	c46%	c60%	0.6-3.6%	1.7-25.0%
Last reported case		Ongoing pandemic	2004	Ongoing outbreaks	2010	Seasonal
Asymptomatic		9.3-30.8%	<3-7.5%	13-81%	77-84%	75-85%
Presenting symptoms						
Fever		48-98%	74-100%	84-98%	87-95%	89-96%
Cough		53-82%	29-100%	63-87%	98-99%	85-99%
Sore throat		32%	14-22%	13-25%	64-68%	73-80%
Myalgia		11-63%	25-61%	32-40%	49-85%	50-86%
Breathlessness		24-54%	29-42%	35-72%	35-56%	32-53%
Diarrhoea (Nausea or Vomiting)		0-48% (27%)	11-27% (5-23%)	20-35% (15-21%)	39% (37-64%)	34% (38-69%)
Fatigue		43-81%	31-45%	38%	90-91%	83-94%
Anosmia (Ageusia)		35-68% (40-71%)	c10-15%	c10-15%	c10-15%	c10-15%
Risk factors for severe disease/death						
Age		>60 years	>50 years	>65 years	<18 and >65 years	<5 and ≥65 years
Sex		Male>Female	Male≤Female	Male>Female	Male>Female	Male≥Female
Immunocompromised (IC)		IC	IC	IC	IC	IC
Co-infection (CI)		CI	CI	CI	CI	CI
Comorbidities		Cardio-metabolic; respiratory	Cardio-metabolic; respiratory	Cardio-metabolic; renal; respiratory	Cardio-metabolic; asthma; pregnancy	Cardio-metabolic; renal; pregnancy
Vaccine		Not yet available[4]	Not yet available	Not yet available	Available	Available
Approved therapeutics		Dexamethasone; Remdesivir[4]	None approved	None approved	Amandatine; Rimantadine; Oseltamivir; Zanamivir; Baloxavir; Peramivir;	

Table S1. Notes:

1. R_0 – the *average*[6] number of new infected *cases*[6] of disease that are directly attributed to the original source case in a population where all individuals are *equally*[6] susceptible to infection;
2. Incubation period – the time between infection and the first appearance of *symptoms*;[6]
3. Serial interval – the *average*[6] or *minimum*[6] time between successive cases in a chain of transmission from one case to the next;
4. Cumulative cases of, and deaths from COVID-19, and the availability of a vaccine or approved therapeutics as of 2nd August 2020;
5. *CFR* (Case Fatality Rate) - the percentage of all individuals *diagnosed with disease*[6] who die *as a result of the disease*[6] over a given period of time;
6. *Emphasis* added to reflect the impact that extensive variation in infectivity, susceptibility, and differences in (a)symptomatology, case definition, cause of death classification and sampling frame and context, can have on these parameter estimates.

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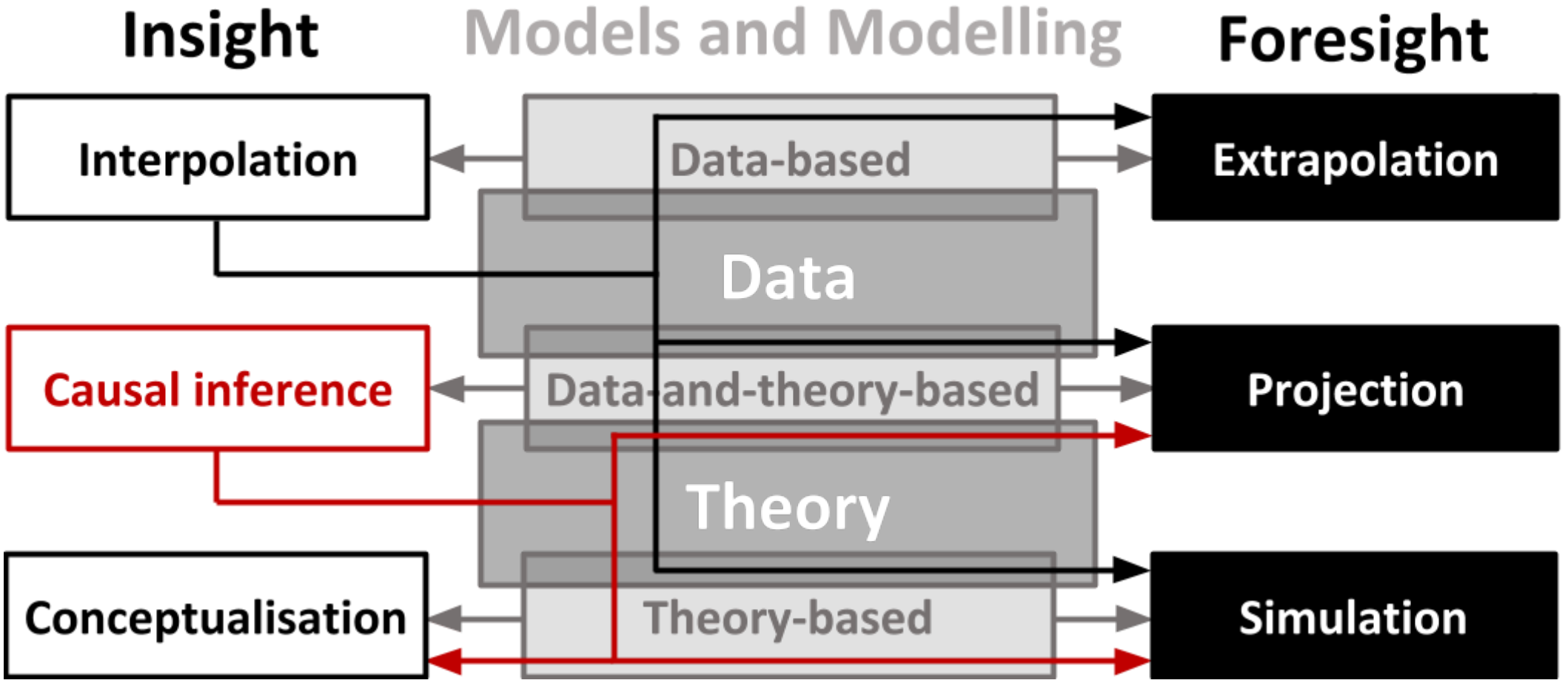

Figure S1. An epistemological framework for the theory-, data- and theory-plus-data-based epidemiological models used to generate insight (through conceptualisation, interpolation and causal inference) and foresight (through simulation, extrapolation and projection), respectively. Each of these models provides (*least* wrong and *most* useful) answers to separate and very different questions; although four are commonly - and somewhat unhelpfully - described (interpolation/classification; extrapolation) or interpreted (simulation; projection) as generating 'predictions'. While models involving simulation, extrapolation and projection might all be capable of generating foresight, their ability to deliver accurate projections (or 'literal predictions') of future events, will depend upon: the (in)stability of the contexts in which they are applied; and how well the models actually reflect the functional mechanisms involved. Importantly, insight from analytical models involving interpolation (→) and causal inference (→) can play a key role in: classifying and characterising such contexts; and strengthening understanding of the underlying 'data generating mechanism' on which accurate and reproducible projections (or 'literal predictions') can then rely.

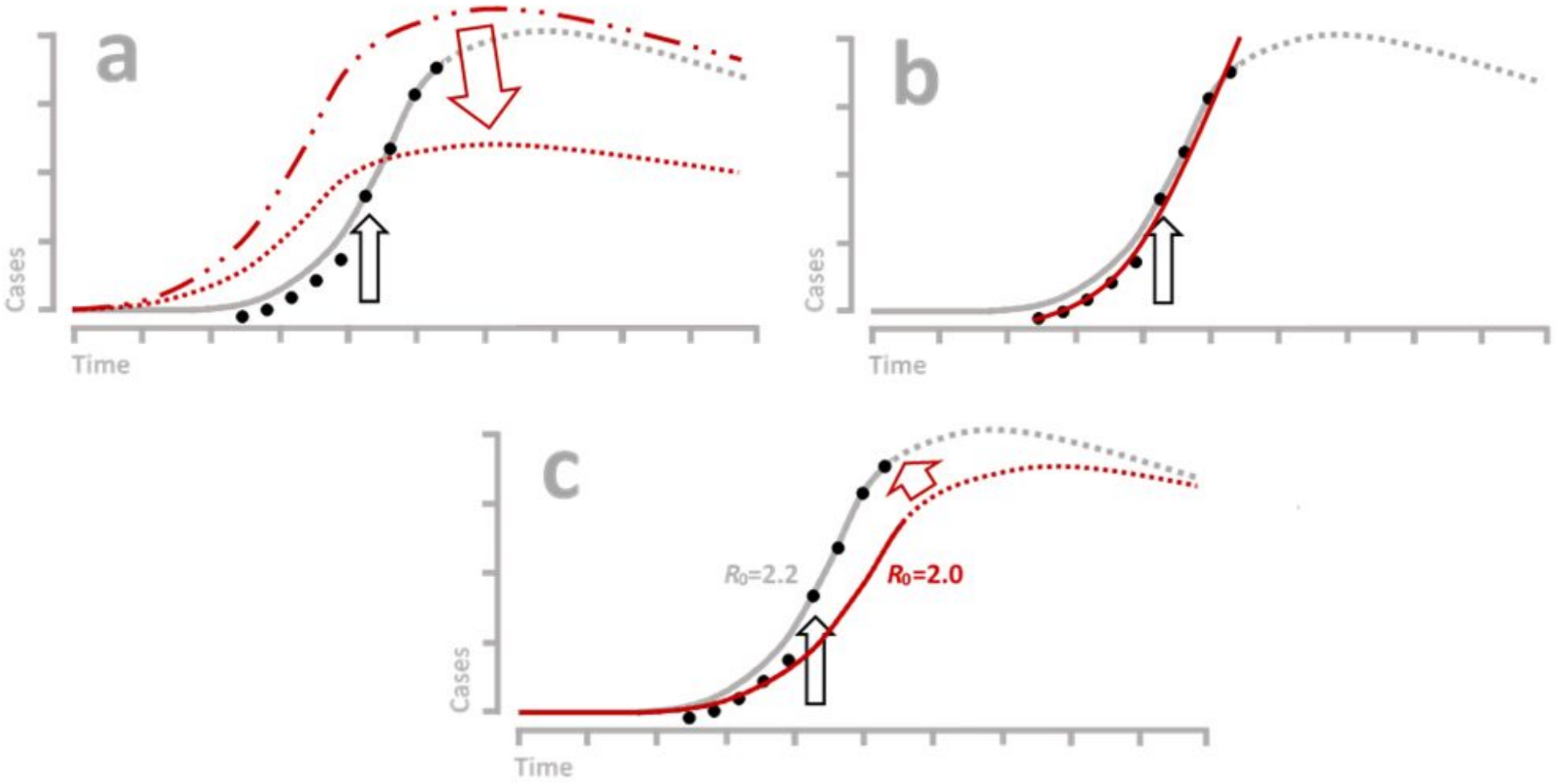

Figure S2. An illustration of the: (**a**) theory-based; (**b**) data-based/driven; and (**c**) 'theory-plus-data'-based modelling techniques that have been used to generate foresight during the COVID-19 pandemic. The solid and dashed grey curve indicates the true attained and future numbers of cases occurring over time, respectively; the filled black dots indicate the daily number of recorded cases - these being systematically *under*-reported initially, but ultimately *correctly* recorded (from the point indicated by the upward black arrow); and the dark red solid (data-driven) and dashed (theory-driven) curves indicate: (**a**) simulations based on different theorised parameters; (**b**) interpolation and extrapolation based on the number of recorded cases; and (**c**) projections based on theorised parameters that are 'tuned' so that the estimated curve better fits the recorded number of cases (in this instance by changing the theorised R_0 from 2.0 to 2.2).