

Supplementary Information: A data-driven semiparametric model of SARS-CoV-2 transmission dynamics in the United States

2022-08-01

John M. Drake, Andreas Handel, Éric Marty, Eamon B. O'Dea, Tierney O'Sullivan, Giovanni Righi, and Andrew T. Tredennick,

Model diagram

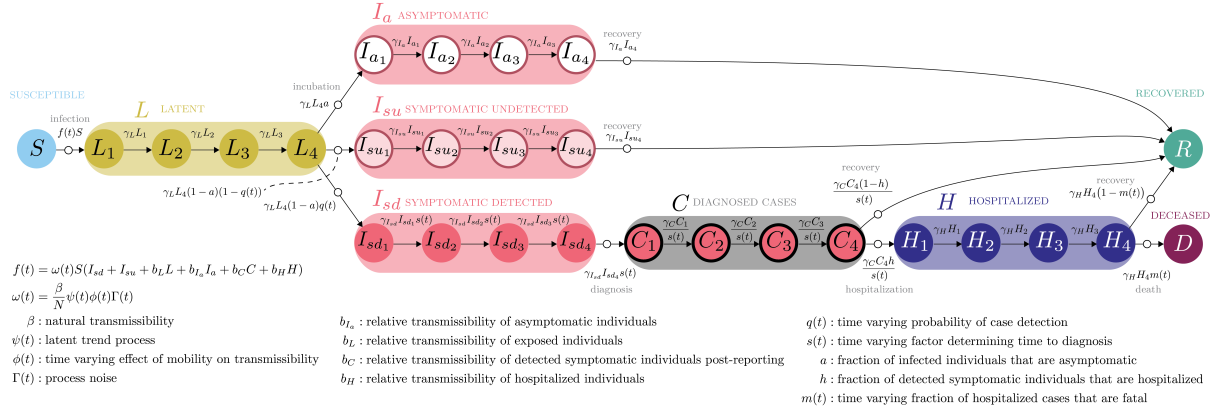


Figure S1: Model diagram.

Model parameters

Table S1: Fixed model parameters.

Parameter definition	Parameter symbol	Value	Source
Reproduction number	\mathcal{R}_0	7	CDC
Fraction of infected individuals that are asymptomatic	a	0.18	ttt
Fraction of diagnosed cases that are hospitalized	h	0.12	ttt
Transmission rate of symptomatic individuals	β	$\mathcal{R}_0 \times 0.1 \times \frac{1}{N}$	—
Relative transmissibility of L to $I_{su/sd}$	b_L	0.12	ttt
Relative transmissibility of I_a to $I_{su/sd}$	b_{I_a}	0.5	ttt
Relative transmissibility of C to $I_{su/sd}$	b_{I_a}	0.27	ttt
Relative transmissibility of H to $I_{su/sd}$	b_{I_a}	4.5×10^{-5}	ttt

Parameter definition	Parameter symbol	Value	Source
Rate of movement through a single L stage	γ_L	$\frac{1}{1 \text{ days}}$	ttt
Rate of movement through a single I_a stage	γ_{I_a}	$\frac{1}{0.88 \text{ days}}$	ttt
Rate of movement through a single I_{su} stage	$\gamma_{I_{su}}$	$\frac{1}{1.5 \text{ days}}$	ttt
Rate of movement through a single I_{sd} stage	$\gamma_{I_{sd}}$	$\frac{1}{0.75 \text{ days}}$???
Rate of movement through a single C stage	γ_C	$\frac{1}{0.75 \text{ days}}$???
Rate of movement through a single H stage	γ_H	$\frac{1}{1.5 \text{ days}}$	ttt
Minimum detection probability	q_{\min}	0.1	ttt
Maximum detection probability	q_{\max}	0.4	ttt
Day at which detection probability is halfway between q_{\min} and q_{\max}	q_{half}	30	ttt
Rate of increase from q_{\min} to q_{\max}	q_r	1.0	—
Maximum factor by which diagnosis speed increases	s_{\max}	1.0	ttt
Day at which diagnosis speed-up factor (s) is halfway between 0 and s_{\max}	s_{half}	30	—
Rate of increase from 0 to s_{\max}	s_r	1.0	—
Initial size of susceptible pool	$S(t = 1)$	N_{state}	—

Table S2: Estimated parameters and starting ranges for MIF estimation procedure.

Parameter definition	Parameter symbol	Start range
Baseline fraction of hospitalizations that result in death	m_{base}	[expit(-6), expit(6)]
Minimum fraction of hospitalizations that result in death	m_{\min}	[expit(-6), expit(6)]
Day at which death fraction is halfway between m_{base} and m_{\min}	m_{half}	[exp(-5), exp(5)]
Extra-demographic process noise	σ	[exp(-5), exp(5)]
Case reporting dispersion	θ_c	[exp(-5), exp(5)]
Death reporting dispersion	θ_d	[exp(-5), exp(5)]
Initial size of latent compartment	$L(t = 0)$	[exp(0), exp(10)]
Initial size of asymptomatic infectious compartment	$I_a(t = 0)$	[exp(0), exp(10)]
Initial size of undetected infectious compartment	$I_{su}(t = 0)$	[exp(0), exp(10)]
Initial size of detected infectious compartment	$I_{sd}(t = 0)$	[exp(0), exp(10)]
B-spline coefficients	g_i	[-10, 10]

Time series of incident case and death reports

Time series of mobility, estimated latent trend, and \mathcal{R}_e