Supplementary Material

Model Equations

We model the dynamics of SARS-CoV-2 using a set of deterministic ordinary differential equations, with susceptible individuals S, exposed individuals E, infected individuals I, and recovered individuals R. Subscripts c and sc refer to clinical and subclinical infections. Subscript v denotes those that are vaccinated. Population size N is constant.

β represents the transmission rate (infectiousness), $\frac{1}{\sigma}$ represents the average latent period, ν represents the proportion of exposed individuals who develop clinical symptoms, $\frac{1}{\gamma}$ represents the average infectious period, and ρ_c represents the probability of death due to clinical infections.

Vaccine 1: reduces risk of clinical infection to 30% of the original value and transmission rate to 70% of the original value:

$\nu_v = 0.3\nu$, $\beta_v = 0.7\beta$

Vaccine 2: reduces risk of clinical infection to 70% of the original value and transmission rate to 30% of the original value:

$\nu_v = 0.7\nu$, $\beta_v = 0.3\beta$

$$\begin{aligned}
\frac{dS}{dt} &= -\beta\frac{S}{N}(I_c + I_{sc}) - \beta_v\frac{S}{N}(I_{c,v} + I_{sc,v}) \qquad (1)\\
\frac{dS_v}{dt} &= -\beta\frac{S_v}{N}(I_c + I_{sc}) - \beta_v\frac{S_v}{N}(I_{c,v} + I_{sc,v})\\
\frac{dE}{dt} &= \beta\frac{S}{N}(I_c + I_{sc}) + \beta_v\frac{S}{N}(I_{c,v} + I_{sc,v}) - \sigma E\\
\frac{dE_v}{dt} &= \beta\frac{S_v}{N}(I_c + I_{sc}) + \beta_v\frac{S_v}{N}(I_{c,v} + I_{sc,v}) - \sigma E_v\\
\frac{dI_c}{dt} &= \nu\sigma E - \gamma I_c\\
\frac{dI_{c,v}}{dt} &= \nu_v\sigma E_v - \gamma I_{c,v}\\
\frac{dI_{sc}}{dt} &= (1-\nu)\sigma E - \gamma I_{sc}\\
\frac{dI_{sc,v}}{dt} &= (1-\nu_v)\sigma E_v - \gamma I_{sc,v}\\
\frac{dR}{dt} &= \gamma(I_c + I_{c,v} + I_{sc} + I_{sc,v})
\end{aligned}$$

Conditions and Parameter Values

Total population size for the simulations was fixed at N =100k and we assume 20% of the population is already in the 'recovered' class R. The initial size of the exposed class E was set to 200 individuals, and values for the I_c and I_{sc} classes were calculated under a fast dynamics assumption:

$$\begin{aligned} I_c = \frac{\nu \sigma E}{\gamma} &= 140 \\ I_{sc} = \frac{(1-\nu)\sigma E}{\gamma} &= 260 \end{aligned}$$

The initial size of the susceptible class $S = 0.8(1-f)N$ and the initial susceptible vaccinated class $S_v = 0.8fN$, where f is the vaccination coverage level. All other vaccinated classes (E_v, $I_{sc,v}$, $I_{c,v}$) are initially set to 0, and simulations were run for one year.

We set the average latent period ($1/\sigma$) to 4.6 days and the average infectious period ($1/\gamma$) to 5 days [18]. We set the transmission rate β to 0.5 per day, resulting in a basic reproduction number of $R_0 = 2.5$ [19]. We set the risk of an unvaccinated individual developing a clinical infection at $\nu = 0.14$ [20], and the risk of dying from a clinical infection at $\rho_c = 0.02$ [21, 22].