Model Details

For synchronized and rotating interventions I use the following simple model that divides the population into two cohorts. I use $A_i(t)$ to denote the activity level of group i at time t. We take $A_i(t)$ to be $A_i(t) = 1 - d_i(t)$ where $d_i(t)$ is a measure of social distancing, and is the fraction of potential contacts that is prevented by social distancing.

$$\begin{aligned}
\frac{dS_1}{dt} &= -\beta A_1 S_1 (A_1 I_1 + A_2 I_2) \\
\frac{dI_1}{dt} &= \beta A_1 S_1 (A_1 I_1 + A_2 I_2) - \gamma I_1 \\
\frac{dS_2}{dt} &= -\beta A_2 S_2 (A_1 I_1 + A_2 I_2) \\
\frac{dI_2}{dt} &= \beta A_2 S_2 (A_1 I_1 + A_2 I_2) - \gamma I_2
\end{aligned}$$

where I_i is the number of people in cohort i that are infected, S is the number of susceptible people, β is the transmission rate upon contact, and γ is the rate of removal from the infected class through both death and recovery. The idea behind this structure is that cohort membership is always maintained, but individuals can potentially be infected by people from the opposite cohort both cohorts are 'active' at the same time. Specifically, individuals from cohort 1 and 2 come into contact with one another at time t at a rate that is proportional to $A_1(t)A_2(t)$. So if the cohorts have different activity levels $A_i(t)$ as a function of time then although within-cohort transmission will always occur, between-cohort transmission can be reduced. To makes things simple, we will take these A_i to be 'square' waves in the case where things are changing temporally.

For the mask wearing intervention I use the very same model but with a single cohort that is always active. In this case A_i is a constant a represents the fraction by which either susceptibility or transmission is reduced by mask wearing.

Appendix to: Shaw J, Day T, Malik N, et al.
Working in a bubble: How can businesses reopen while limiting the risk of COVID-19 outbreaks?
CMAJ 2020. doi: 10.1503/cmaj.201582.