## COVID-19 Model Containing Contact Tracing and Quarantine

## 1 Model Equations

$$S_{j+1} = S_j - S_j \alpha c \left( \frac{I_P + b_c I_C + b_a I_A}{N} \right) - (r \delta_E E_{j-4}) q (1 - \alpha) c (b_c (S_j + S_{j-1}) + (S_{j-2} + S_{j-3})) \frac{1}{N}$$
 (1)

$$E_{j+1} = E_j - S_j \alpha c \left( \frac{I_P + b_c I_C + b_a I_A}{N} \right) - (r \delta_E E_{j-4}) q \alpha c (b_c (S_j + S_{j-1}) + (S_{j-2} + S_{j-3})) \frac{1}{N} - \delta_E E_j$$
 (2)

$$I_{P_{j+1}} = I_{P_j} + r\delta_E E_j - \delta_{I_P} I_{P_j} \tag{3}$$

$$I_{C_{j+1}} = I_{C_j} + \delta_{I_P} I_{P_j} + \delta_Q Q_j - \delta_{I_C} I_{C_j}$$
(4)

$$I_{A_{j+1}} = I_{A_j} + (1-r)\delta_E E_j - \delta_{I_A} I_{A_j}$$
 (5)

$$Q_{j+1} = Q_j + (r\delta_E E_{j-4})cq\alpha r(b_c(S_j + S_{j-1}) + (S_{j-2} + S_{j-3}))\frac{1}{N} - \delta_Q Q_j$$
(6)

$$Q_{A_{j+1}} = Q_{A_j} + (r\delta_E E_{j-4})cq\alpha(1-r)(b_c(S_j + S_{j-1}) + (S_{j-2} + S_{j-3}))\frac{1}{N} - \delta_{Q_A}Q_{A_j}$$
(7)

$$S_{Q_{j+1}} = S_{Q_j} + (r\delta_E E_{j-4})q(1-\alpha)c(b_c(S_j + S_{j-1}) + (S_{j-2} + S_{j-3}))\frac{1}{N} - \delta_{S_Q}S_{Q_j}$$
(8)

$$R_{j+1} = R_j + \delta_{I_C} I_{C_j} + \delta_{I_A} I_{A_j} + \delta_{Q_A} Q_{A_j} \tag{9}$$

## 2 Parameters

- ullet c : Contact rate between an infectious individual and susceptible individuals
- $\alpha$ : Probability of transmission given a contact
- $\tau$ : Days for covid-19 test results
- r: Probability that an exposed individual becomes presymptomatic and move to  $I_P$
- $\bullet$  q: Contact tracing effectiveness rate
- $\bullet$   $b_A$ : Decrease in asymptomatic infectivity
- $b_C$ : Decrease in clinical infectivity
- $\delta_E$ : Mean time spent in Exposed
- $\delta_{I_P}$ : Mean time spent in Infected Pre-Clinical

- $\delta_{Q_A}$ : Mean time spent in  $Q_A$
- $\delta_{S_Q}$ : Mean time spent in  $S_Q$