S – Susceptible
I_p – Infectious, pre-symptomatic
I_c – Infectious, symptomatic
I_a – Infectious, asymptomatic
N – Total Population

S_1^v & S_2^v ? (i.e. # doses)

α – $\mathbb{P}$(infection | contact)
c – contact rate
b_c – reduced contact rate | symptomatic
b_a – reduced "α" due to asymptomatic
k – $\mathbb{P}(CT \mid I_c)$ (maybe not a const.?)
q – CT effectiveness
τ – days between infections & CT
v – vaccine rate
δ_i – 1/# days in i (assumes lin. growth?)
r – $\mathbb{P}(E \to I_p \mid E)$
ε – vaccine efficacy
c^v – contact rate | vaccination

Miller Preprint: $b_a = 0.5$
$\delta_E = \frac{1}{4}$
$b_c = \{0.1, 0.5, 1\}$
$\delta_{I_p} = \frac{1}{2.4}$
$\delta_{I_c} = \frac{1}{3.2}$
$\delta_{I_a} = \frac{1}{7}$

NFL COVID Data: $V = 6\%$ /wk
↳ 1 dose

Carcione SEIR: $\frac{1}{\delta_E} = \frac{1}{4.25}$
↳ Italy 1st wave
$\frac{1}{I} = \frac{1}{4}$
$*\beta = \alpha \cdot c = \frac{3}{4}$ /day

CDC.Gov: $r = 0.7$
$b_a = 0.75$
$\frac{1}{\delta_E} + \frac{1}{\delta_{I_p}} = 6$
$t(I_c \to (+ve)\text{ test}) = 2$ days
↳ $\tau = 2 + CT$
$R_0 = 2.5$
transmission due to

Silent Transmission: $r \in (0.692, 0.821)$

⊥ of age
$$\begin{cases} \frac{1}{\delta_{I_a}} = 5 \\ \delta_{I_p} = \frac{1}{2.3} \\ \delta_{I_c} = \frac{1}{3.2} \end{cases}$$

$$\frac{dS}{dt} = -\frac{S(t)\cdot\alpha\cdot c\cdot[I_p + b_c I_c + b_a I_a]}{N(t)} - \frac{kI_c\cdot q\cdot(1-\alpha)\cdot c\cdot\tau\cdot S}{N} + \delta_{S_q} S_q - vS$$

$$\frac{dE}{dt} = \frac{S\cdot\alpha\cdot c\cdot[I_p + b_c I_c + b_a I_a]}{N} - \frac{kI_c\cdot q\cdot\alpha\cdot c\cdot\frac{1}{\delta_E}\cdot S}{N} - \delta_E E$$

$$\frac{dI_p}{dt} = r\delta_E E - \frac{kI_c\cdot q\cdot\alpha\cdot c\cdot X_1\cdot S}{N} - \delta_{I_p} I_p \quad , \quad X_1 = \min\left(\frac{1}{\delta_{I_p}}, \tau - \frac{1}{\delta_E}\right)$$

$$\frac{dI_c}{dt} = \delta_{I_p} I_p - \delta_{I_c} I_c$$

$$\frac{dI_a}{dt} = (1-r)\delta_E E - \frac{kI_c\cdot q\cdot\alpha\cdot c\cdot X_2\cdot S}{N} - \delta_{I_a} I_a \quad , \quad X_2 = \min\left(\frac{1}{\delta_{I_a}}, \tau\right)$$

$$\frac{dQ}{dt} = \frac{kI_c\cdot q\cdot\alpha\cdot c\cdot X_3\cdot S}{N} - \delta_Q Q \quad , \quad X_3 = X_1 + r\cdot\frac{1}{\delta_E}$$

$$\frac{dQ_a}{dt} = \frac{kI_c\cdot q\cdot\alpha\cdot c\cdot X_4\cdot S}{N} - \delta_{Q_a} Q_a \quad , \quad X_4 = X_2 + (1-r)\cdot\frac{1}{\delta_E}$$

$$\frac{dS_q}{dt} = \frac{kI_c\cdot q\cdot(1-\alpha)\cdot c\cdot\tau\cdot S}{N} - \delta_{S_q} S_q$$

$$\frac{dS^v}{dt} = vS - \frac{S^v\cdot\alpha\cdot c^v\cdot(1-\varepsilon)\cdot[I_p + b_c I_c + b_a I_a]}{N}$$

$$\frac{dI^v}{dt} = \frac{S^v\cdot\alpha\cdot c^v\cdot(1-\varepsilon)\cdot[I_p + b_c I_c + b_a I_a]}{N} - \delta_{I^v} I^v$$

$$\frac{dR}{dt} = \delta_{I_c} I_c + \delta_{I_a} I_a + \delta_Q Q + \delta_{Q_a} Q_a - vR$$

$$\frac{dR^v}{dt} = \delta_{I^v} I^v + vR$$