Modeling SARS-CoV-2 Infection Risk in Various Office Building HVAC Systems: Online Materials

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I-P Nomenclature

C: *volume concentration of infectious quanta* [quanta ft^{-3}]

I: *number of asymptomatic infected individuals*

k: *removal contribution factor in space by deposition (gravitational settling)* [h^{-1}]

N: *total removal factor in the space, $N = \lambda + k + rn$* [h^{-1}]

NS: *total number of people involved (asymptomatic infected individuals + susceptible individuals)*

n_0: *initial level of infectious quanta present in volume V (at t = 0)* [quanta]

P: *probability of infection referred to any exposed susceptible individual*

p: *pulmonary inhalation rate by one susceptible individual* [cfm]

q: *infectious quanta emission rate by one asymptomatic infected individual* [quanta h^{-1}]

R:* *average number of susceptible potentially infected people from one contagious person (reproduction index under the specific situation)*

rn: *fresh (outdoor) air renewal factor* [h^{-1}]

rc: *air recirculation factor* [h^{-1}]

T, t *time* [h]

V: *volume* [ft^3]

λ: *removal contribution factor in space by viral inactivation* [h^{-1}]

η_f: *first pass removal/inactivation efficiency in recirculation*

Subscript

$_I$: *room of the infected person*

$_R$: *recirculate air*

$_S$: *susceptible people's room(s)*

I-P Equations

Equation 1 (I-P):

$$P = 1 - e^{-60p \cdot \int_0^T C_I(t)\mathrm{d}t}$$

Equation 2 (I-P):

$$C_I = \frac{qI}{NV} + \left(\frac{n_0}{V} - \frac{qI}{NV}\right) e^{-N \cdot t}$$

Equation 3 (I-P):

$$P = 1 - \exp\left[\frac{q \cdot I \cdot 60p}{V}\left(\frac{1 - N \cdot T - e^{-N \cdot T}}{N^2}\right)\right]$$

Equation 4 (I-P):

$$\frac{\mathrm{d}C_I}{\mathrm{d}t} = \frac{q \cdot I}{V_1} + rc \cdot C_R - (rc + N) \cdot C_I$$

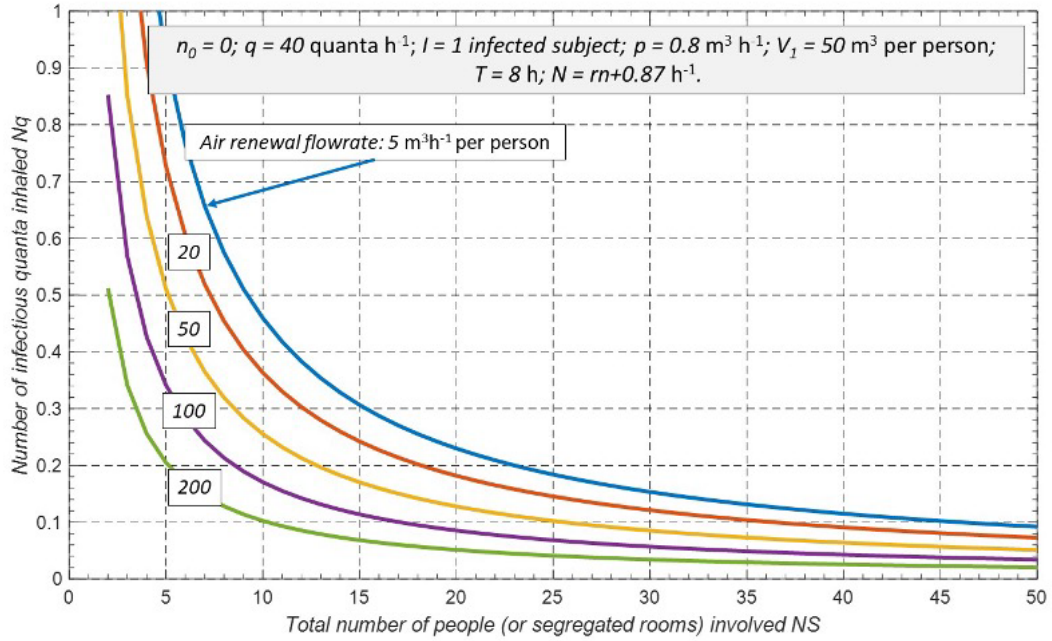
Equation 5 (I-P):

$$\frac{\mathrm{d}C_S}{\mathrm{d}t} = rc \cdot C_R - (rc + N) \cdot C_S$$

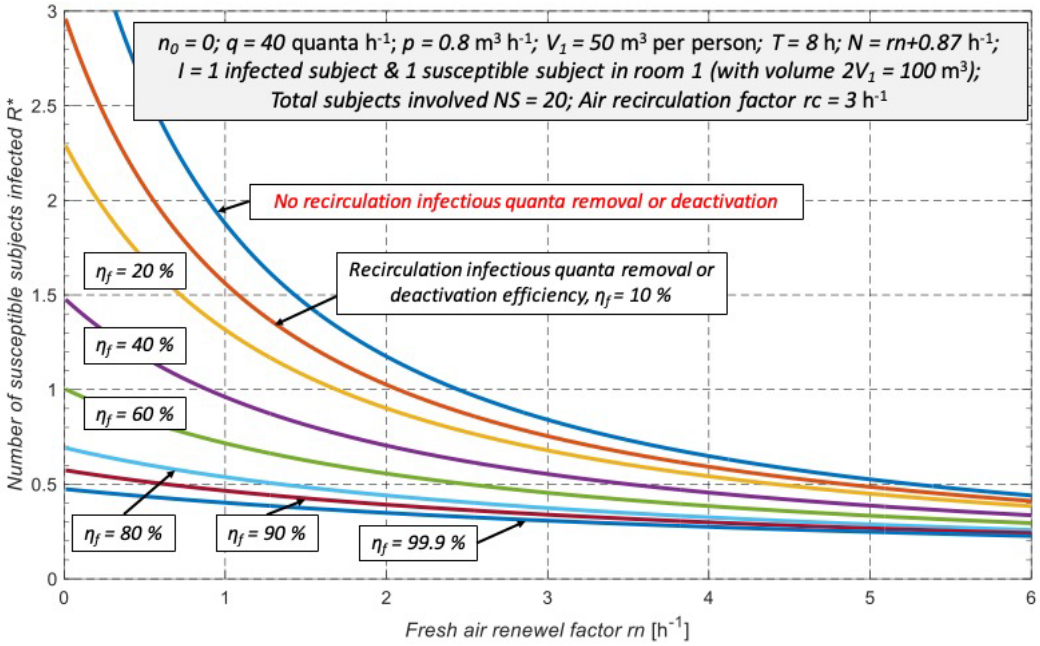
Equation 6 (I-P):

$$C_R = \frac{C_I + (NS - 1) \cdot C_S}{NS}$$

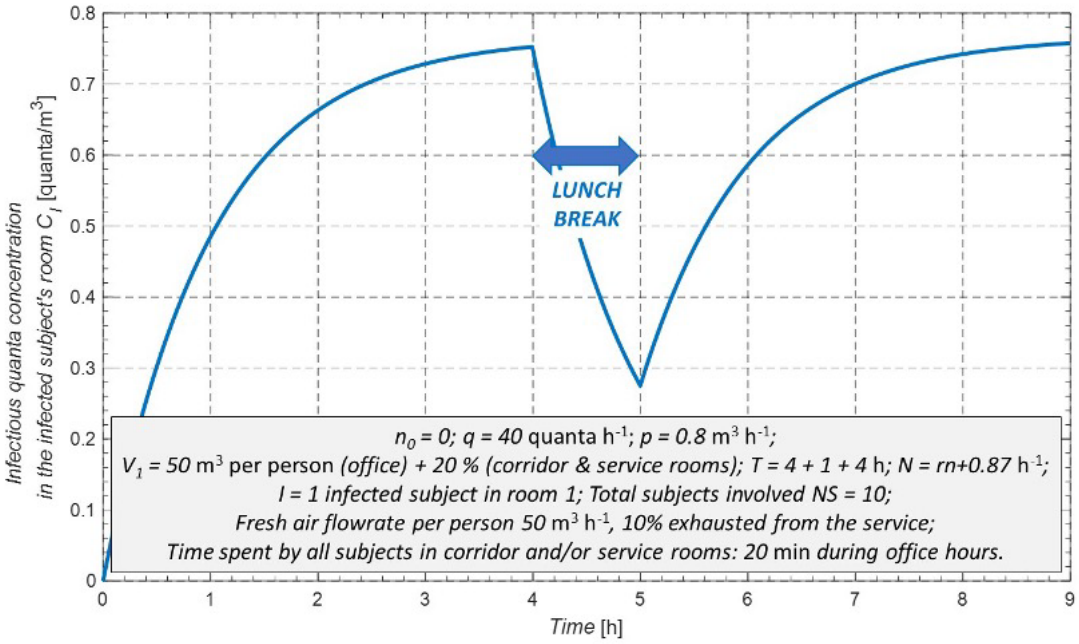
Online Figures



Online Figure 1. Concentration of infectious doses inhaled after 8 h.



Online Figure 2. Effect of the outdoor air renewal rate for different removal/inactivation efficiencies (with q = 40 quanta h^{-1}).



Online Figure 3. Concentration of infectious quanta in the infected room 1.