Electronic Supplementary Material (ESI) for Environmental Science: Atmospheres.


# Appendix

## 1. Short-range airborne transmission models

### 1.1. Diffusion model

A modified model for spherical turbulent eddy diffusion plus advection was adopted by Wagner et al. (2021). The original droplet size-dependent model is simplified as below to account for the virus concentration adopted by the exposed person who are directly downwind, facing the infector:

$$C_{\mathrm{s}} = \frac{C_0 Q_0}{4\pi\epsilon_d (d - B_x)} \times e^{-0.5 \times \frac{U}{\epsilon_d} \times (d - B_x)}$$

$$\epsilon_d = V_{\mathrm{room}}{}^{2/3} \times \left[\left(0.52 \times Q/V_{\mathrm{room}}\right) + 0.31\right]$$

$C_{\mathrm{s}}$ – virus exposure, viruses/m$^3$

$C_0$ - average concentration of exhaled aerosols at the jet origin (approximately at the mouth)

$Q_0$ - expired flow rate, L/h

U – wind speed, m/s

d – distance from infector, m

$B_x$ - initial cloud size, at a distance from the mouth where the jet flow and turbulence become indistinguishable from the ambient values, m

$\epsilon_d$ - the turbulent eddy diffusivity, cm$^2$/s

$V_{\mathrm{room}}$ - room volume, m$^3$

Q – ventilation rate, m$^3$/h

### 1.2. Jet model

The short-range airborne transmission model we adopted according to the study of Li et al. (2) :

$$C_s = C_0\left(\gamma\alpha + \frac{1 - \gamma\alpha}{S}\right)$$

$$\alpha = Q_0/Q$$

$$S = 0.32d/d_m$$

$\gamma$ - the fraction of infectious aerosol in the suspended aerosols in the expired jet that remain suspended in the room zone

$\alpha$ – rebreathed fraction

$d_m$ – mouth diameter, m

## 2. Base case

The parameters for the base case are provided in detail in Table S1. We selected these parameters primarily based on the studies conducted by Wagner et al. (1) and Li et al. (2).

**Table S1.** Parameters for base case.

| Parameters | Volume [$m^3$] | Infector number | Respiratory activity | Physical activity | $B_x$ [m] | U [m/s] | $d_m$ [m] | $Q_0$ [L/s] | $\gamma$ | D [m] | Q [$m^3$/h] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Base case | 34 | 1 | speaking | light activity | 0.012 | 0.1 | 0.02 | 0.2 | 0.9 | 1 | 0.5*34 |

## References


1. Wagner J, Sparks TL, Miller S, Chen W, Macher JM, Waldman JM. Modeling the impacts of physical distancing and other exposure determinants on aerosol transmission. J Occup Environ Hyg [Internet]. 2021 Sep 13;1–15. Available from: https://www.tandfonline.com/doi/full/10.1080/15459624.2021.1963445
2. Li Y, Cheng P, Jia W. Poor ventilation worsens short-range airborne transmission of respiratory infection. Indoor Air [Internet]. 2021 Oct 27; Available from: https://onlinelibrary.wiley.com/doi/10.1111/ina.12946