Supplementary material

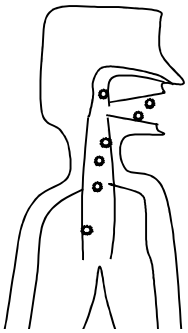
(Lee, B.U. (2021). Why Does the SARS-CoV-2 Delta VOC Spread So Rapidly? - Universal Conditions for the Rapid Spread of Respiratory Viruses, Minimum Viral Loads for Viral Aerosol Generation, Effects of Vaccination on Viral Aerosol Generation, and Viral Aerosol Clouds. *Int. J. Environ. Res. Public Health*)

1. Analysis details

This theoretical analysis of the minimum viral load for viral aerosols is based on the assumptions of a homogeneous distribution of viruses in respiratory fluids, considering one gene copy as a single virion, and a spherical volume ratio model for both respiratory particles and viruses [1].

Assumption: (Virus size: 0.09 micrometer)

Analysis 1

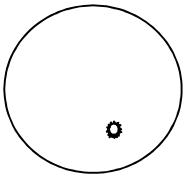


Viral loads in respiratory fluids > $1.9 \cdot 10^6$ copies per mL

$\{(1/6)(pi)(d_{virus})^3\}/\{(1/6)(pi)(d_{respiratory\ fluid\ particle})^3\}$

= The volume ratio of viruses in the released respiratory fluid particles to the total particle volume (spheres)

$> 7.3 \cdot 10^{-8}$ %



Minimum size of respiratory fluid particles potentially carrying SARS-CoV-2

< 100 micrometer

Supplementary-Figure 1. Minimum viral load required for aerosol transmission (assumptions: the aerosol-droplet cutoff particle diameter to distinguish aerosols from droplets for respiratory particles is assumed to be 100 micrometer; homogenous distribution; virus size = 0.09 micrometer [sphere, d_{virus}] assumption; one gene copy=a single virion)

$(1.9 \cdot 10^6$ copies) / (1 mL)

$= [1.9 \cdot 10^6 \cdot \{(1/6)(pi)(0.09 \cdot 10^{-6}m)^3\}] / (10^{-6}m^3)$

$= \{(1/6)(pi)(0.09 \cdot 10^{-6}m)^3\} / \{(1/6)(pi)(d_{respiratory\ fluid\ particle})^3\}$

$d_{respiratory\ fluid\ particle}$=100 micrometer

References

1. Lee, B.U. Minimum sizes of respiratory particles carrying SARS-CoV-2 and the possibility of aerosol generation. *Int. J. Environ. Res. Public Health* 2020, 17, 6960, https://doi.org/10.3390/ijerph17196960.