Respiratory Virus Propagation Modeling: Using SARS-CoV-2 as a case study

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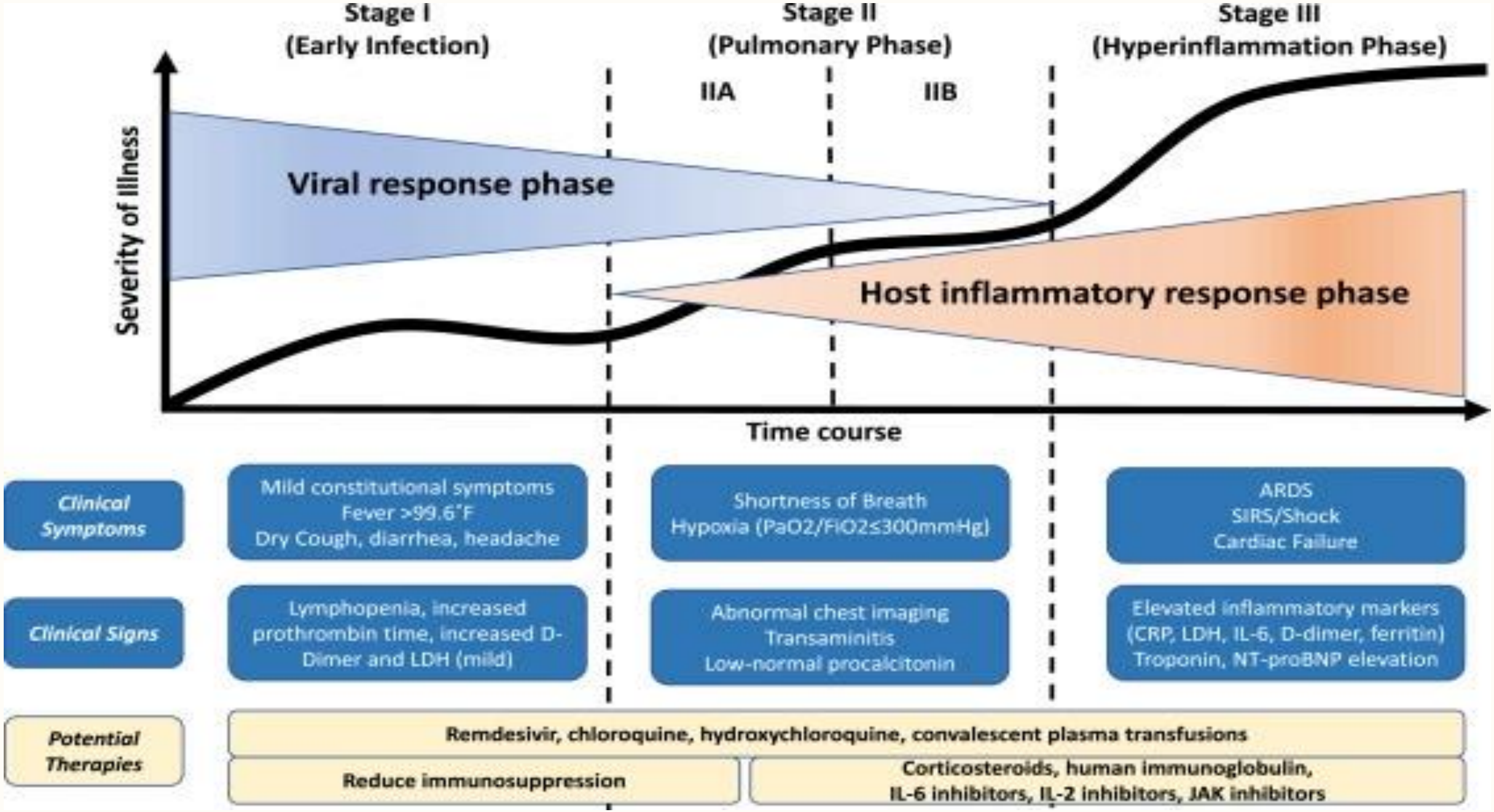


Taken from Siddiqi et al., The Journal of heart and Lung Transplanation, 2020

Upper respiratory tract

Nasal cavity

Pharynx

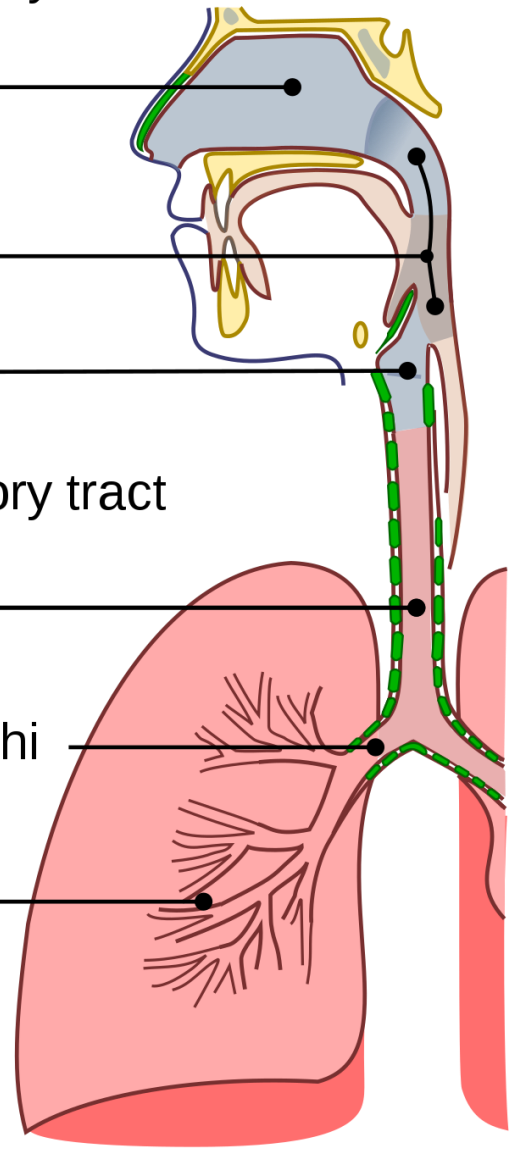
Larynx

Lower respiratory tract

Trachea

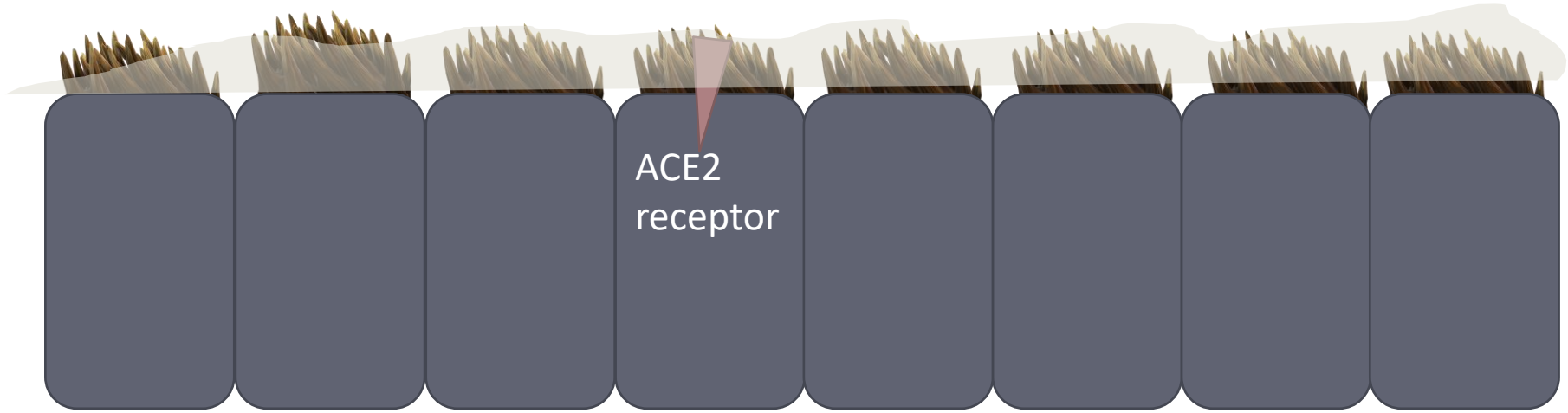
Primary bronchi

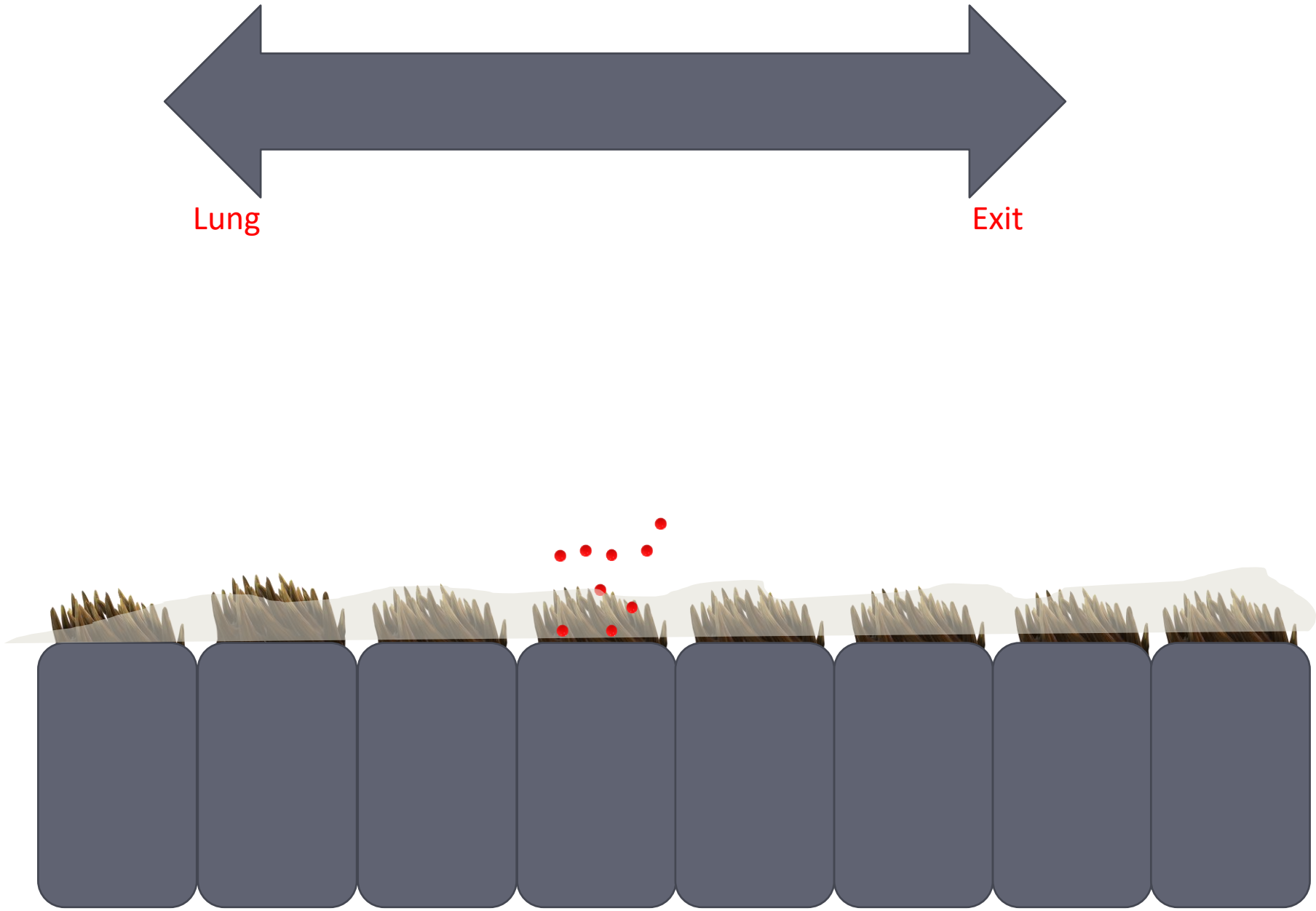
Lungs



IFN response
Cytokines such as IL6, IL12
NK cells, Macrophage, Monocyte
T-cell response

Genetic makeup
Age
Lifestyle




Lung
Exit

Aim of the Study

Build a Mathematical model to characterize respiratory viral infection dynamics along the respiratory tract.

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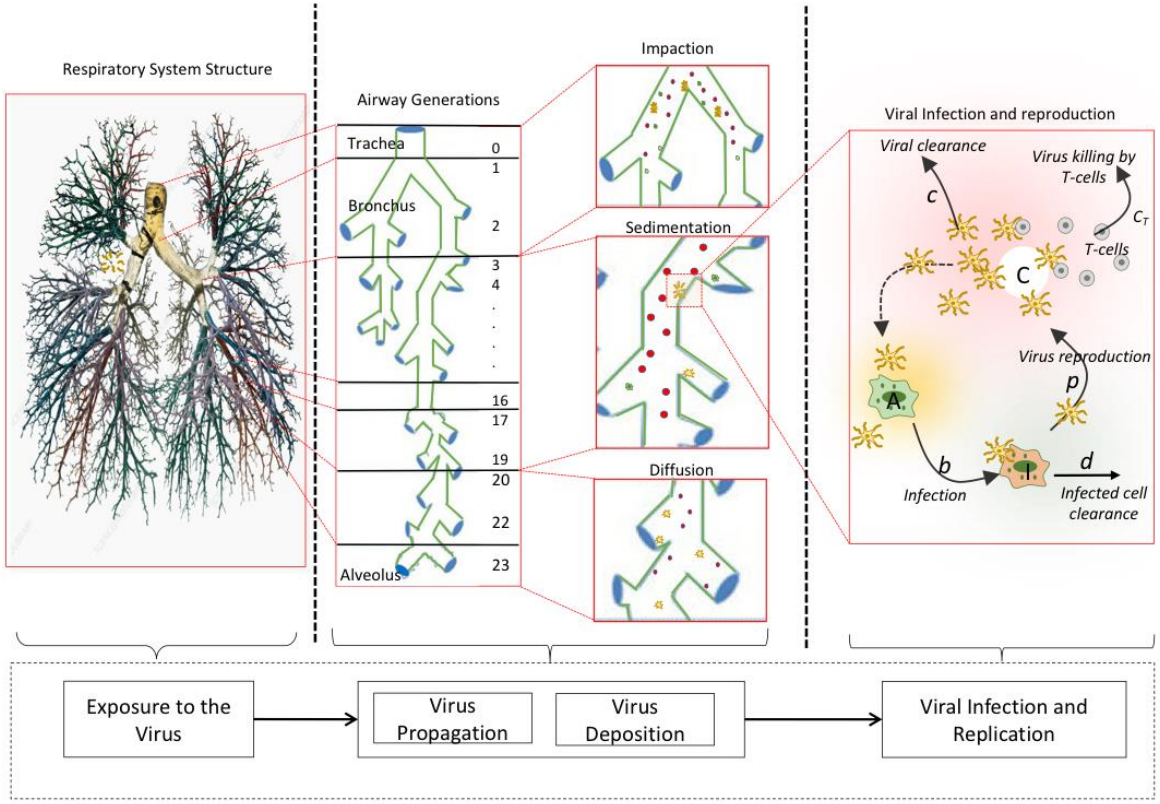
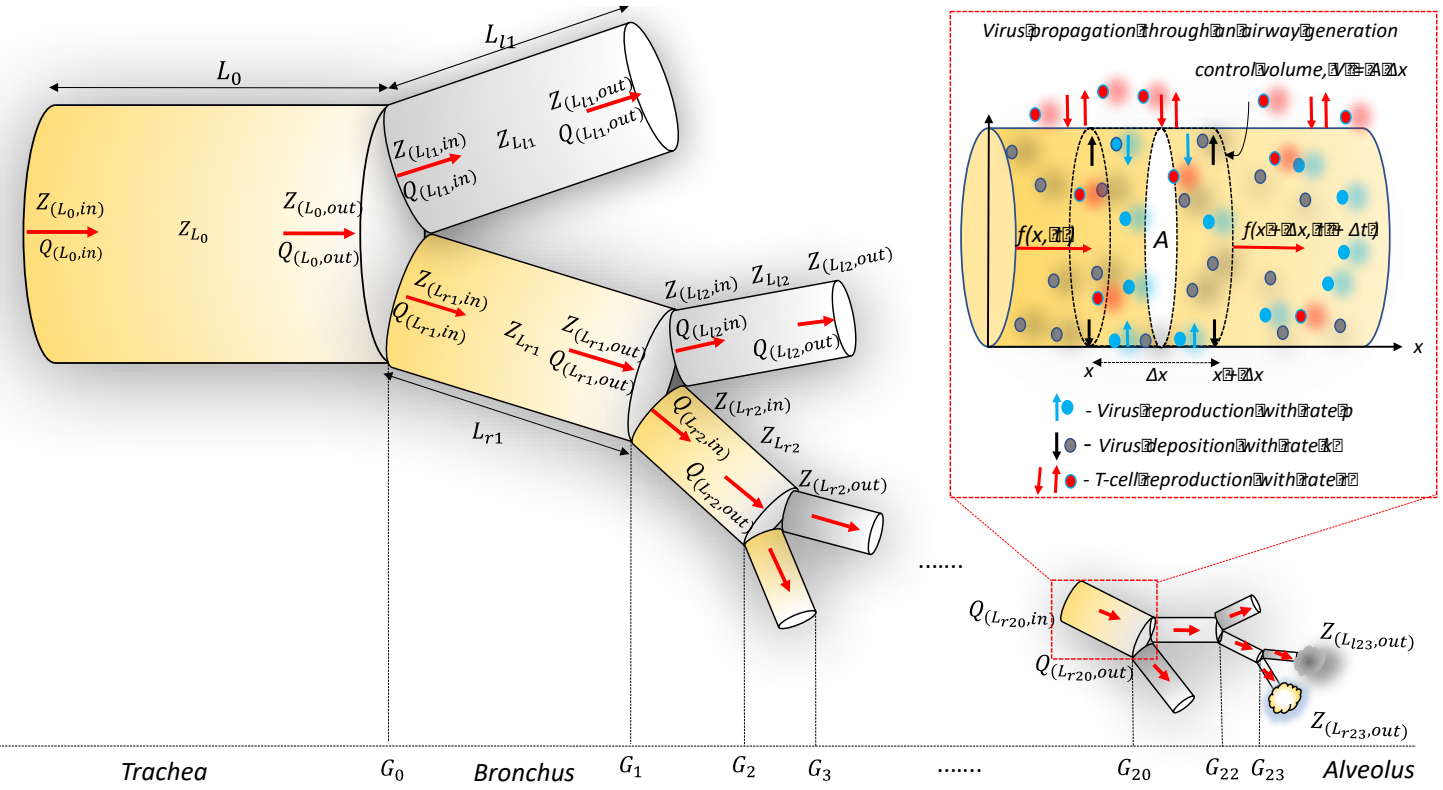


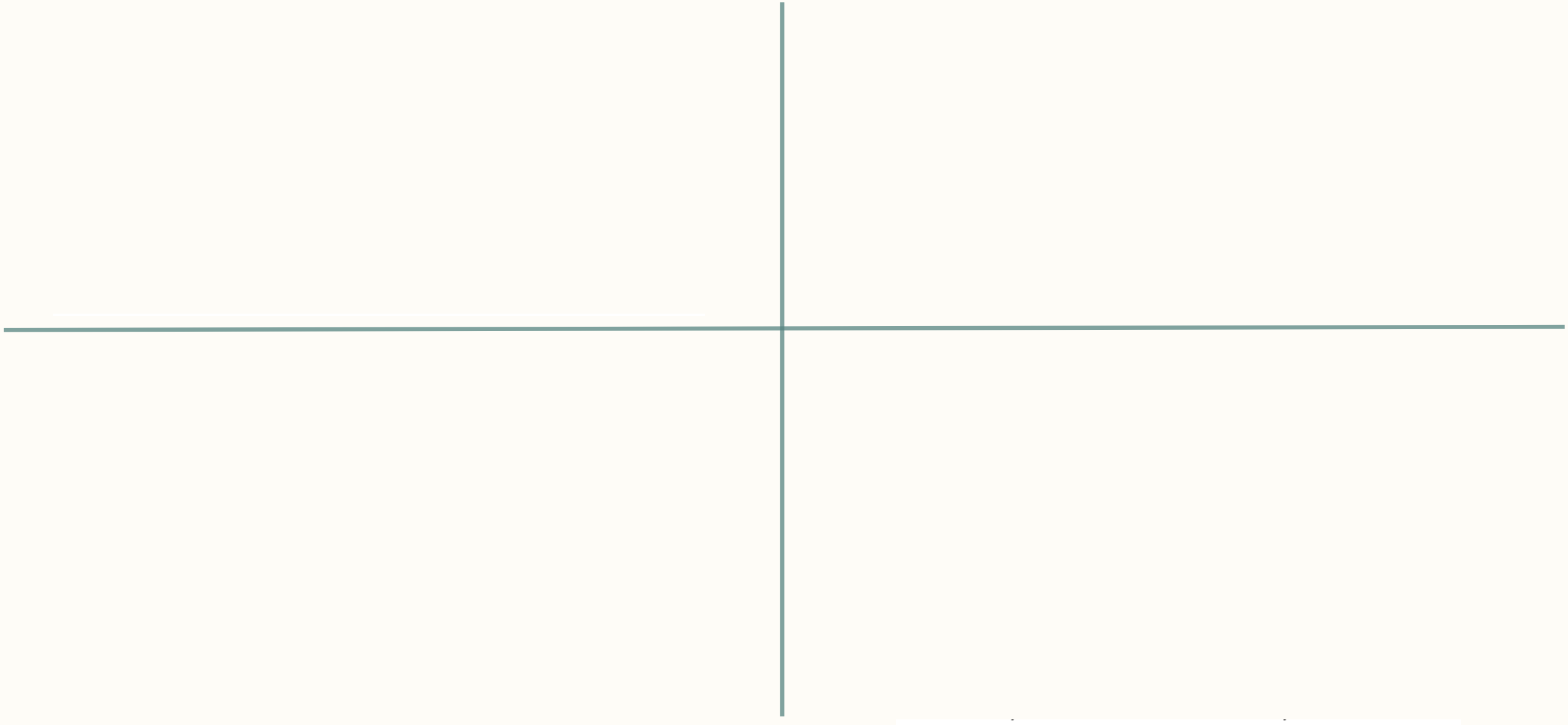
1. The geometry of the respiratory system
2. Propagation of virus particles
3. Deposition of virus particles
    a) Impaction
    b) Sedimentation
    c) Diffusion
4. Viral infection and reproduction.

Mathematical Model



Model Outcomes: Virus Dynamics

SARS-CoV-2 Dynamics with Different Factors



Advantages and Challenges

- Advantages
  1. Can be applied to explore dynamics of any respiratory infection,
  2. Design personal need based therapeutic treatments,
  3. Enables exploring other viral infections, given physiological characteristics of the mostly affected organ (e.g., digestive system).
- Challenges
  1. Lack of experimental data
  2. SARS-CoV-2 dynamics are still being investigated (e.g., impact of full immune response)

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Thanks for your attention

Any Question ?

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