The Structure of Exhaled Droplets and Aerosols – Preliminary Work

Engineering and Physical Sciences Research Council

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BACKGROUND

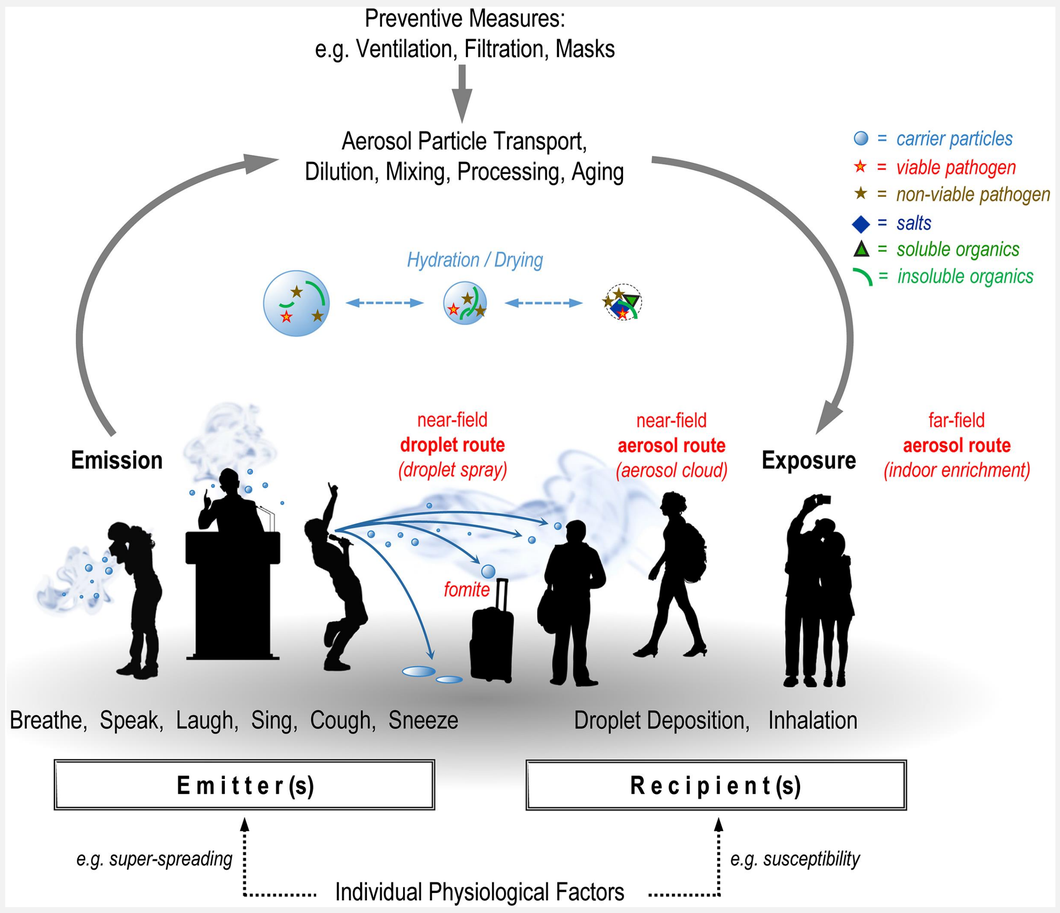

Figure 1. Illustrative representation of respiratory aerosol and droplet of disease transmission (Pöhlker et al. 2023)

- Exhaled aerosols are responsible for the transmission of many respiratory diseases and infections
- Droplet size and their suspension time in the ambient environment is dependant on their origin in respiratory tract
- Despite the prevalence of these sub-100 micron particles, **a detailed understanding of composition and structure of these particles is lacking**[3]
- **Limited characterization is reported**

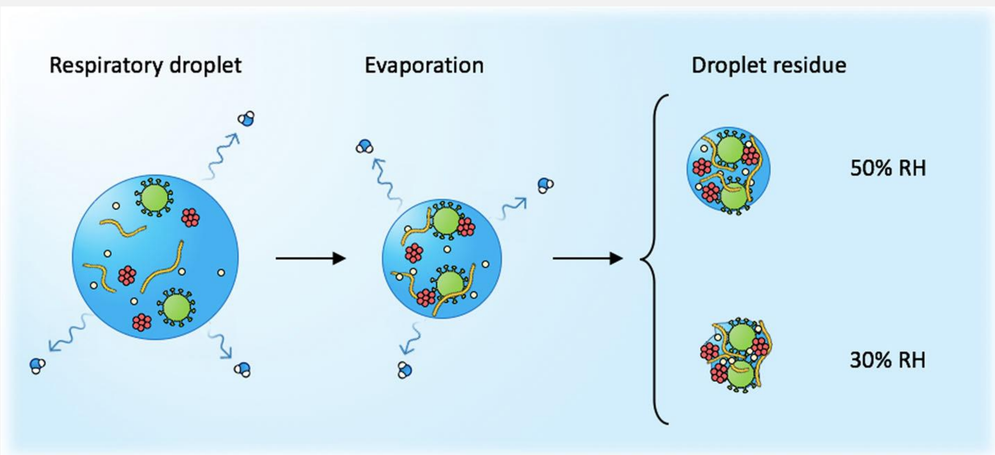

Figure 2. Drying process of a respiratory droplet. Image taken from (Božič and Kanduč 2021)

METHODOLOGY

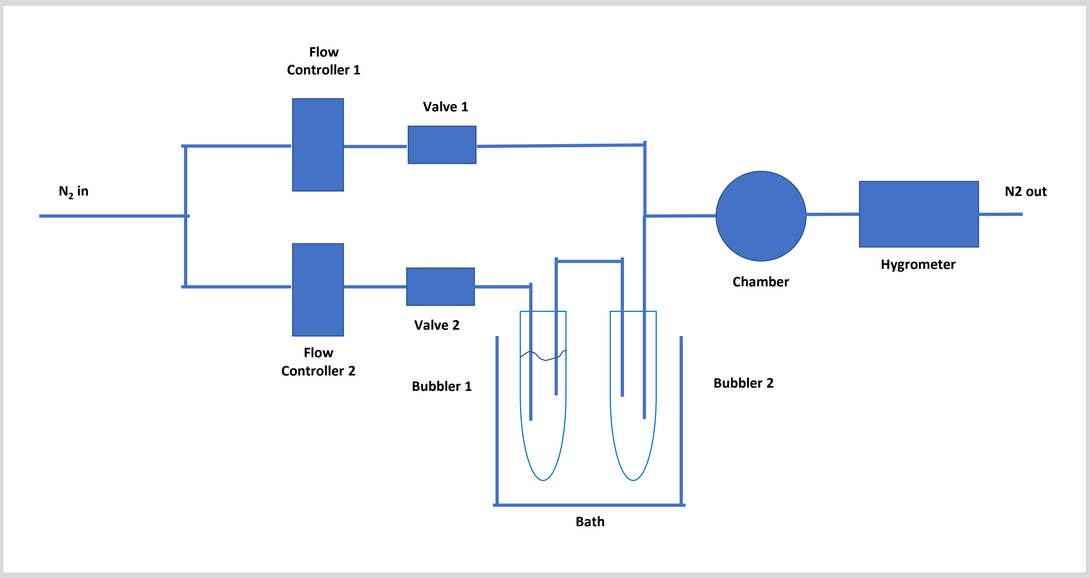

Figure 3. Schematic of the experimental setup

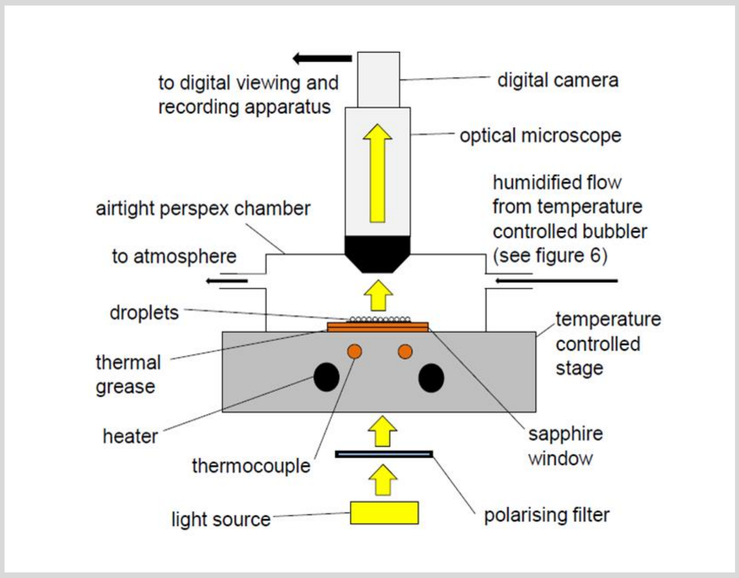

Figure 4. Schematic of the RH controlled chamber

- Relative Humidity (RH) was controlled in the chamber by the ratio of wet and dry flow
- Video were recorded on computer and were analysed
- Samples were also retrieved for SEM analysis (in process)

RESULTS

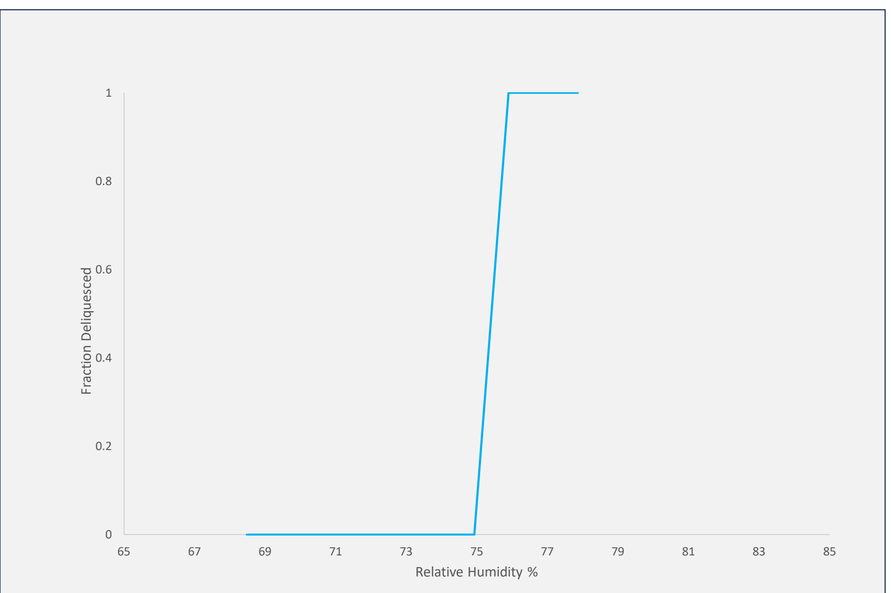

Figure 5. Deliquescence of NaCl

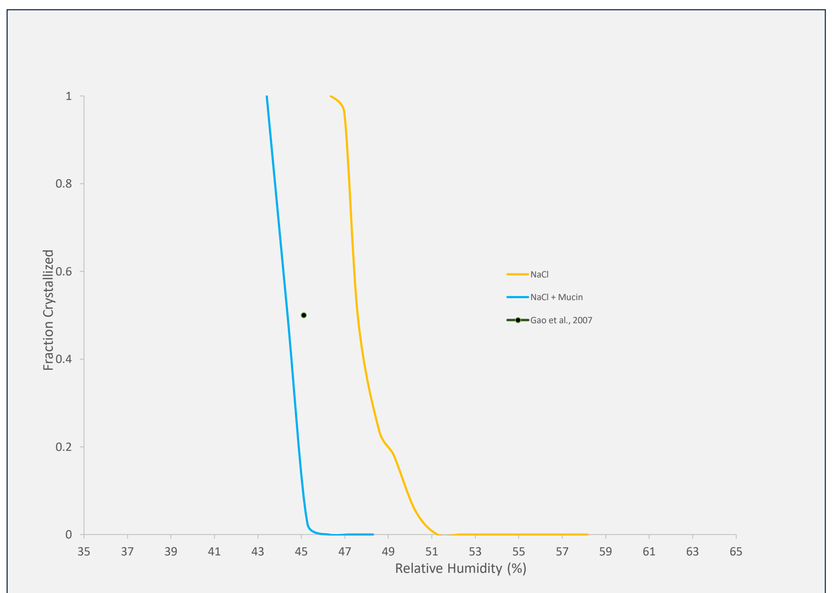

Figure 6. Efflorescence curve obtained from ramping experiment (~1% / 5 min)

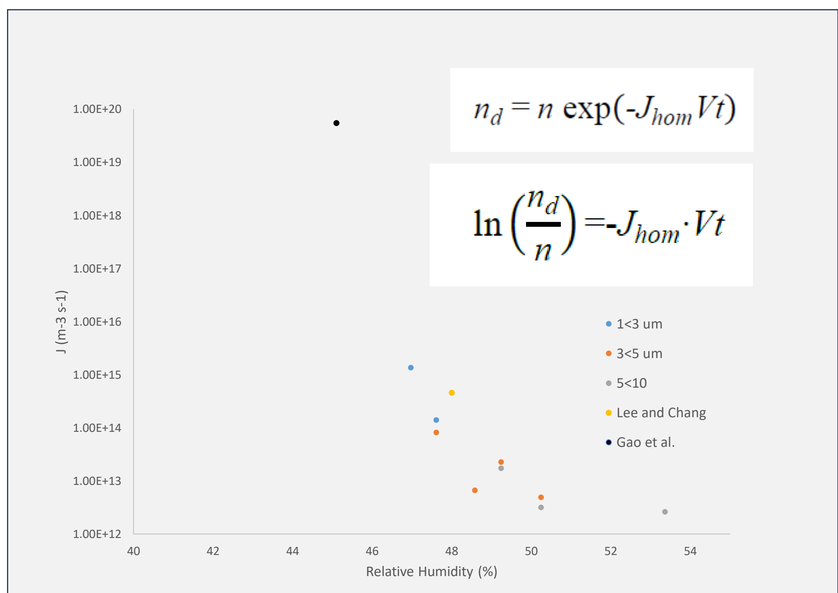

Figure 7. Homogenous nucleation of NaCl

CONCLUSSION

- The deliquescence is in accordance with literature
- The efflorescence of NaCl is in the same range as reported in literature
- The solution containing mucin has a lower efflorescence range than NaCl only
- Homogenous nucleation of NaCl is as expected with bigger droplets nucleating first and smaller later

FUTURE WORK

- Further experiments with different ratios of different components of the solution
- Making the solution more representative of lung fluid by adding other components (surfactants) to it to characterize the impacts on the crystallization of NaCl
- Sampling exhaled aerosol using a cascade impactors for characterization using various Electron microscopy techniques

REFERENCES

1. Pöhlker, M. L., et al. (2023). Reviews of Modern Physics **95**(4): 045001
2. Božič, A. and M. Kanduč (2021). Journal of Biological Physics **47**(1): 1-29.
3. Poon, W. C., et al. (2020). Soft matter **16**(36): 8310-8324.
4. Vejerano, E. P. and L. C. Marr (2018). Journal of the Royal Society Interface **15**(139)