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Exhaled particles and viruses from humans

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Introduction

Respiratory infection of viruses affects many persons every year, having a large economic and societal impact. Droplets and droplet nuclei from speaking, coughing, and sneezing has been investigated at least since in 1946 (Duguid, 1946), up until present day where the Covid-19 pandemic shed a light on the importance of understanding airborne transmission of infectious disease. This study aims to continue this work by examining exhaled aerosol particle size distribution, concentration, and its viral content, from approximately 150 test persons with acute respiratory infection.

Method

Measurement of exhaled particles and virus from test subjects with acute respiratory infection will take place in a climate-controlled (temperature, relative humidity) chamber of 36 m3 with HEPA-filtered air. The test subjects will breathe, vocalize, and chough into a funnel which feeds the exhaled air to several instruments measuring and collecting aerosol particles. A few weeks later, when the test subject has recovered, the measurements will be repeated to investigate the difference between the infected and healthy state. Dry particle size concentrations between 0.3-20 µm will be estimated with an aerodynamic particle sizer (APS 3321, TSI Inc., US) and an optical particle counter (OPC, model 11-D, Grimm Aerosol Technik Ainring, Germany). Exhaled CO2 concentration and H2O content will be measured with a LI-COR 850 CO_2/H_2O gas analyzer (LI-850, LI-COR Biosciences, Germany). A portion of the exhaled aerosol particles will be collected into liquid collection media using a BioSpot (Model 300-P, Aerosol Devices Inc.) for virus analysis. Virus quantification will be performed with qPCR.

Results

Anticipated outcomes are a better understanding of which and to what extent acute respiratory infections give rise to exhaled viruses, and how the size distribution and concentration of exhaled aerosol during respiratory infection compares to a healthy state.

Discussion and Conclusions

During the covid-19 pandemic, we learned that aerosol transmission contributed, especially in the early phase. It is likely that other acute respiratory infections also can spread though aerosol transmission, which would have implications for infection prevention strategies throughout society. The outcomes from this study will contribute to a better understanding of acute respiratory infection's ability to spread via aerosol transmission.

References

Duguid, J. P., 'The Size and the Duration of Air-Carriage of Respiratory Droplets and Droplet-Nuclei', Epidemiology and Infection, 44 (1946), 471–79 http://dx.doi.org/10.1017/S0022172400019288

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