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Surveillance of respiratory pathogens through environmental air sampling and effectiveness of air purifiers: monitoring 6 congregate settings during a respiratory season.

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Background and aim

Many respiratory pathogens, including SARS-CoV-2, are transmitted by airborne aerosols and can cause outbreaks within settings such as nurseries, schools, and nursing homes. We aim to explore if environmental air sampling can complement disease surveillance in these contexts. In a sub-study, we evaluated the effect of mobile air purifiers on the pathogen detection and load in 2 nursery units.

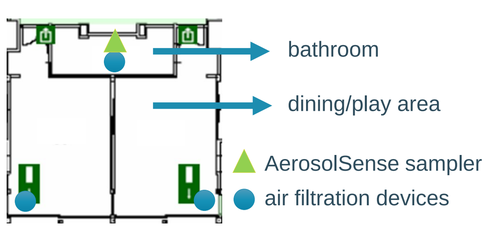
Methodology

Indoor air sample collection (Oct 2021- April 2022)

1. Congregate settings

- Nursery (0-3y)
- Kindergarten (3-6y)
- Primary school (6-12y)
- Secondary school (12-18y)
- University/pub (18+)
- Nursing homes (65+)

2. Filtration devices in nursery units



+/- 2h indoor air sampling with AerosolSense device
(Thermo Fisher Scientific)

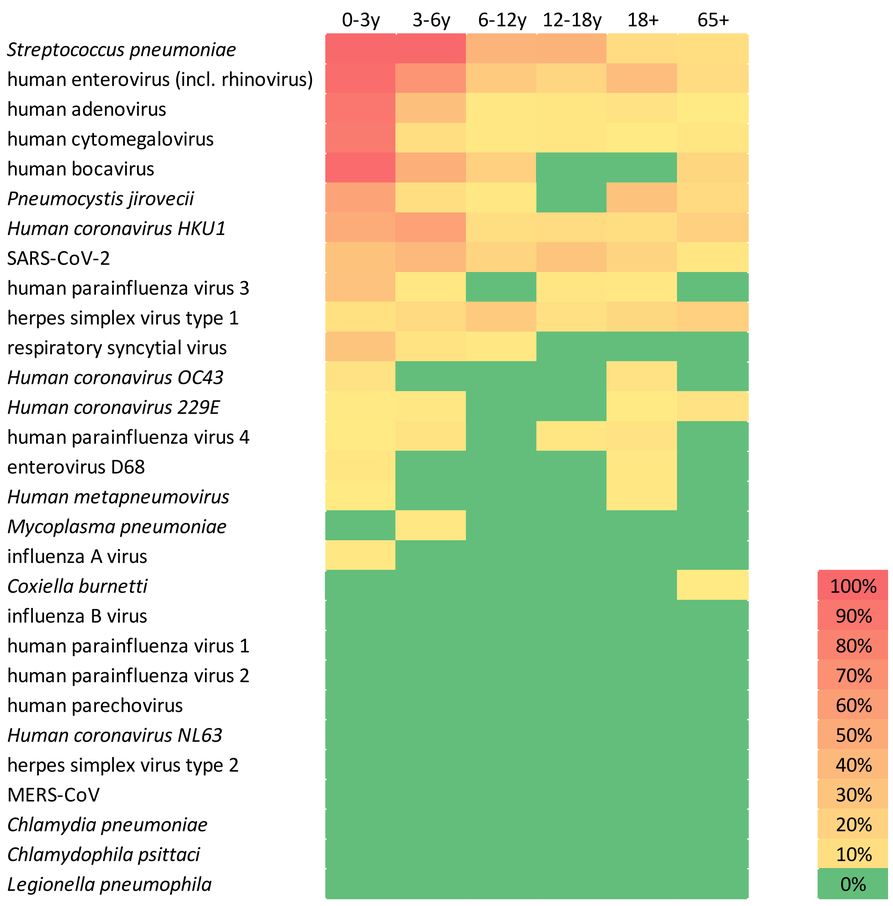
Multiplex qPCR

InActiv Blue (Fertipro) → TaqPath COVID-19 CE-IVD RT-PCR Kit (Thermo Fisher Scientific)

UTM (Copan) → LDT respiratory panel (29 pathogens)

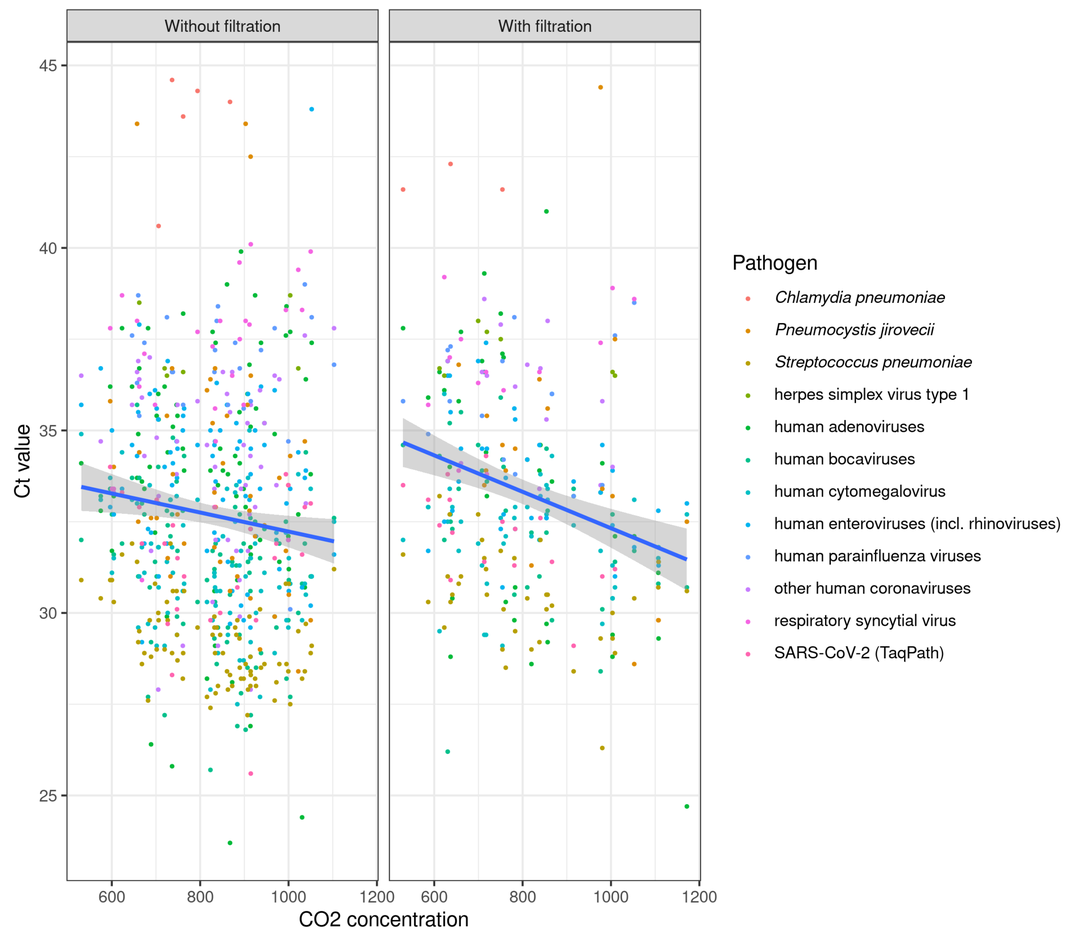
Results

1. Positivity rate of respiratory pathogens in air samples



Between October 2021 and April 2022, 335 samples were collected. Nineteen out of 29 pathogens were detected at least once. In nurseries (0-3y), *Streptococcus pneumoniae*, human bocavirus, entero-/rhinovirus, human adenovirus and human cytomegalovirus were systematically identified, and a maximum of 9 pathogens were detected concomitantly. Concurrently with a resurgence observed at the national level or documented within the setting, SARS-CoV-2 and respiratory syncytial virus were intermittently detected.

2. Influence of air filtration on pathogen concentration



This graph shows the relationship between Ct value and CO_2 concentration in a dataset of aerosol samples collected in childcare settings. The blue lines indicate a univariate linear model, with the 95% confidence interval in gray. Only positive results are shown. Pathogens which were detected fewer than 10 times are excluded. The results demonstrate that air filtration, especially in combination with low CO_2 concentration, results in lower pathogen concentration in the indoor air.

Conclusion

We observed intense dissemination of respiratory pathogens in the indoor air of congregate settings, with the highest number of pathogens found in settings hosting children under 3 years. These observations support the need to increase air quality in settings massively exposed to airborne pathogens (nurseries) or particularly vulnerable to some of these diseases (nursing homes). Such interventions could prevent part of the medical, economic and social burden associated with respiratory diseases. Our results suggest that portable air filtration devices may provide an added benefit over ventilation.