SARS-CoV-2 in Exhaled Breath

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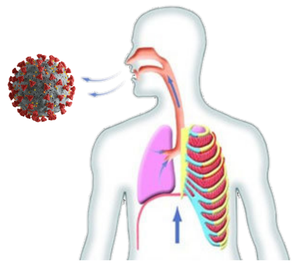
Introduction/Background



COVID-19 is understood to spread through exhaled droplets and aerosols containing SARS-CoV-2. Despite this, very little research has focused on directly measuring SARS-CoV-2 in exhaled breath.
We have developed a device that can be used to collect exhaled breath condensate from COVID-19 patients. Using our device, we can quantify levels of SARS-CoV-2 in exhaled breath of COVID-19 patients. Our device is portable, inexpensive and simple enough that patients can self-collect samples in their own homes. Using our technique, we can study levels of infectious over the course of infection for individual patients, and from this data, aim to develop a COVID-19 spreader test.

Goals/Hypothesis/Questions

Aim 1: To determine if it is possible to detect and measure SARS-CoV-2 in exhaled breath
Aim 2: To characterize the inter-patient variability of SARS-CoV-2 levels in exhaled breath
Aim 3: To characterize the time course of SARS-CoV-2 shedding levels over the course of infection

Methods/Strategies

Exhaled breath collection: We developed a simple device that is based around a syringe tube with plunger, fitted with a mouth piece, valve and cooling sleeve. The device works by condensing droplets and aerosols on the cooled inside wall as warm exhaled breath flows through the tube. After a 10 min breathing session, approximately 1 to 2 mL of liquid sample can be obtained by plunging through the tube into a sample vial.
Analysis of exhaled breath: Samples undergo microfiltration, followed by RNA extraction, followed by RT-qPCR with TaqMan probes.

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Fig 1. SARS-CoV-2 is measurable in exhaled breath

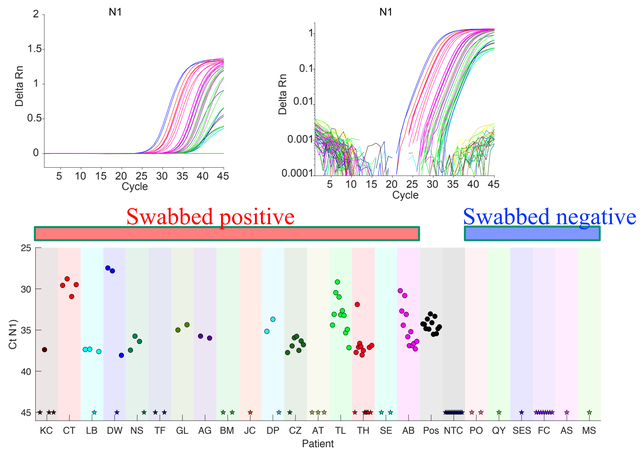
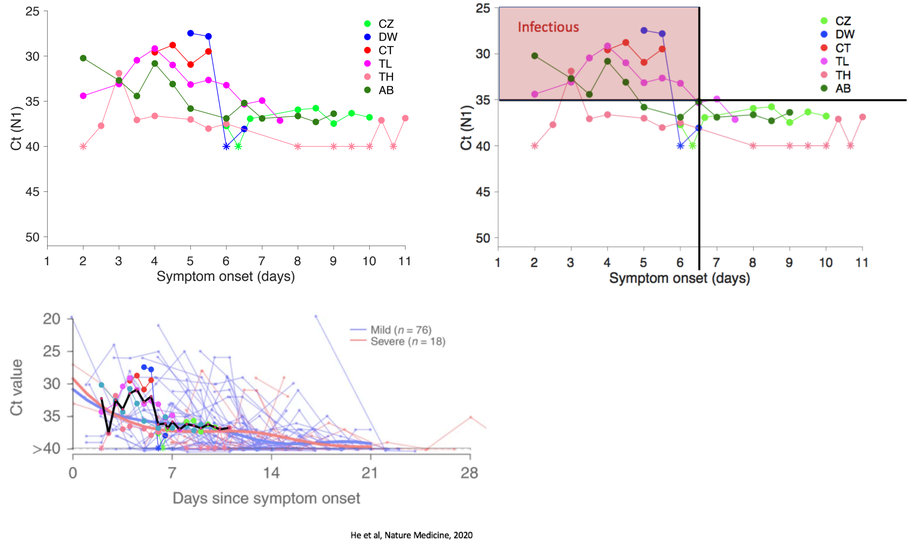


Fig 2. Exhaled SARS-CoV-2 levels over infection course



He et al, Nature Medicine, 2020

Results/Findings/Lessons Learned

- SARS-CoV-2 is measureable in exhaled breath of COVID-19-positive patients.
- Levels of exhaled SARS-CoV-2 are higher at earlier stages of infection, apparently peaking around days 2 to 4 since symptom onset.

Conclusions/Implications

- Producing exhaled breath samples is simple to perform, noninvasive and easily repeatable, making this a viable method to develop a test of infectiousness for Covid-19.

Importance of the Work

- Understanding and measuring shedding of SARS-CoV-2 on exhaled breath is key to understanding transmission of the virus from one person to another.
- Refining understanding of the degree of respiratory exertion necessary for transmission SARS-CoV-2 is critical for control of the disease: Is simply breathing adequate for transmission or is coughing, sneezing, talking, etc, required?
- A standardized protocol for measuring exhaled SARS-CoV-2 will allow determination of how contagious an individual patient is at any given moment over the course of their infection
- This tool could potentially be used to refine recommendations about quarantine durations, and to identify so-called super-spreaders

Fig 3. Controls