

Clinical Updates: COVID-19

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COVID-19 patients in earlier stages exhaled millions of SARS-CoV-2 per hour



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Total of 76 subjects

- 57 patients with COVID-19
- 4 patients without COVID-19 from Hospital A and Hospital B
- 15 healthy subjects in Beijing as controls
- 10 countries

26 air samples were taken using two machine types

242 surface swabs (10 or 25 cm²) in quarantine hotels and hospitals or personal items from COVID-19 patients were obtained using wet cotton swabs

All the samples collected were analyzed using RT-PCR

Results

Toilet room had the highest SARS-CoV-2 positive rate (16.7%, n=12), followed by the Hospital floor (12.5%, n=16)

	Exhaled breath condensate (n=52)	Air sample (n =26)	Surface swabs (n=242)
Sample SARS-CoV-2 positive rate	14/52 (26.9%)	1/26 (3.8%)	13/242 (5.4%)
Cycle Threshold (Ct) range* (N or ORF1a/b)	35.54 ± 3.14	38.40	36.38 ± 1.92
Estimated SARS-CoV-2 emission rate/level	(1.03 x 10 ⁵ , 2.25x 10 ⁷) viruses/hour	6.07 x 10 ³ viruses/m ³	(7.10 x 10 ³ , 1.72 x 10 ⁵) viruses/cm ²

Detection of SARS-CoV-2 and its positive rates from 52 EBC samples collected from 49 COVID-19 patients, 26 air samples, and 242 surface swabs. SARS-CoV-2 emission rate or concentration level in air or on surface was estimated based on an assumed amplification efficiency of 75%; and a RT-PCR detection limit of 100 copies/ μL ¹⁰. Lower and upper bounds of virus emission rates or levels corresponded to upper and lower bounds of Ct values

Discussion

- SARS-CoV-2 is released directly into the air via breathing by COVID-19 patients
- SARS-CoV-2 breath emission rate into the air was the highest, up to 10^5 viruses per min, during the earlier stages of COVID-19
 - Observed Ct values show that SARS-CoV-2 levels in exhaled breath could reach 10^5 - 10^7 copies/m³ if an average breathing rate of 12 L/min is assumed
 - SARS-CoV-2 breath emission rate is affected by many factors such as disease stage, patient activity, and possibly age
- SARS-CoV-2 emission was not continuous at the same rate, but was rather a sporadic event
- SARS-CoV-2 presence in the toilet room air might be due to the exhaled virus or the virus aerosolization from the toilet
- Exhaled breath emission plays an important role in SARS-CoV-2 emission into the air
- Enhanced ventilation and the use of face masks are essential to minimize the risk of infection by airborne SARS-CoV-2

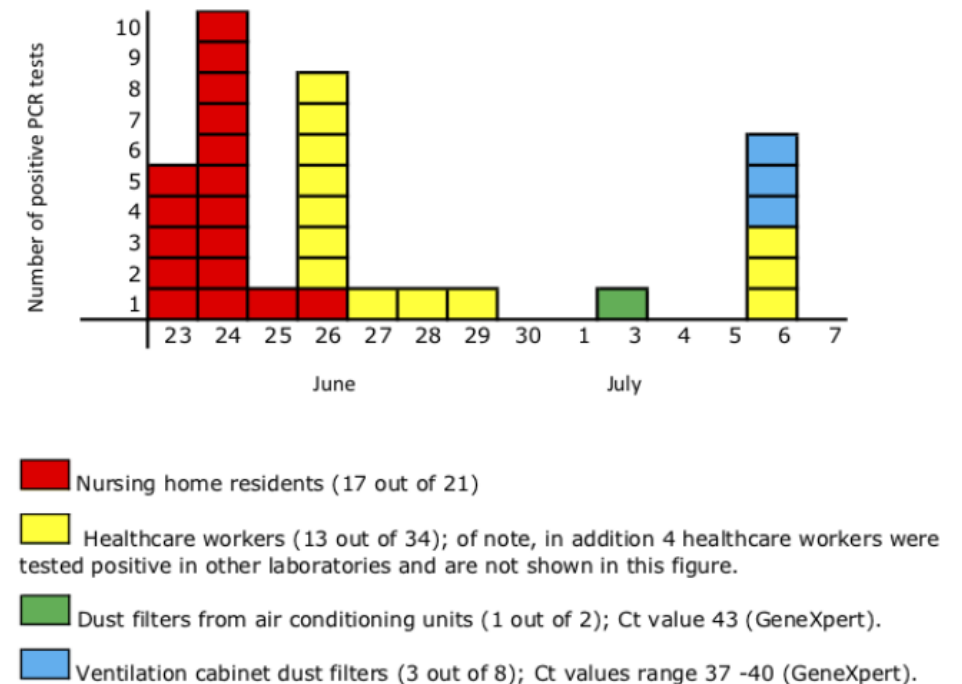
Outbreak of COVID-19 in a nursing home associated with aerosol transmission as a result of inadequate ventilation

Letter to the editor in response to another article addressing airborne transmission of COVID-19

7 wards of a nursing home for people with psychiatric or behavioral conditions

- 1 of 7 wards had an outbreak
- 17 residents and 17 staff
- None (0) of the 95 residents or 106 healthcare staff in the other 6 wards tested positive

Because of the remarkable increase of COVID-19 infections in a very short time period despite the use of surgical masks, the ventilation system of the outbreak ward was investigated in addition to routine source and contact tracing



Investigation Results:

What happened in this ward compared to the other 6?

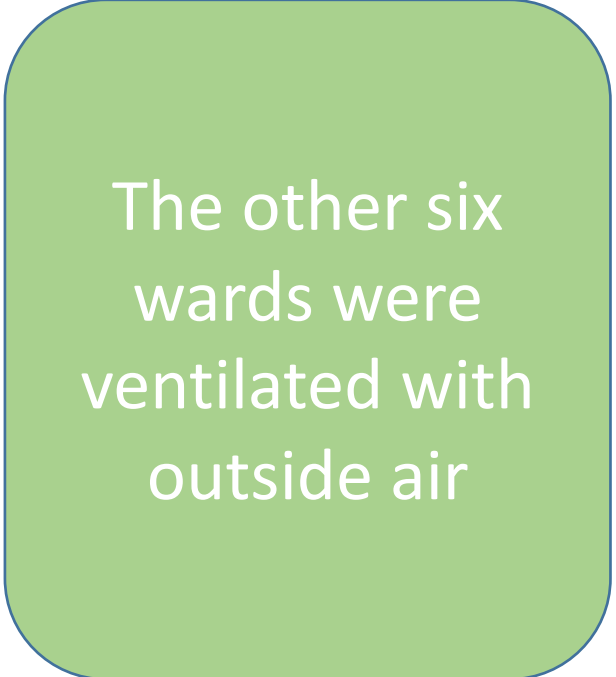
CO₂ controlled energy-efficient ventilation system

Indoor air was only refreshed with outside air based on real time CO₂ concentration measurements

If the CO₂ concentration did not exceed 1000 ppm, the ventilation cabinets recirculated indoor air back into the ward without filtration

Additionally, this ward was cooled by two air conditioning units, which recirculated air through a 1 mm mesh dust filter.

SARS-CoV-2 RNA was detected in dust present on the mesh of the living room air conditioners and in four block filters from three of the eight ventilation cabinets



The other six wards were ventilated with outside air

Opinion Piece – JAMA

Airborne Transmission of SARS-CoV-2: Theoretical Considerations and Available Evidence

Although it is an opinion, it provides a good review of the droplet vs. airborne qualities of SARS-CoV-2, comparing to other diseases that are well documented

The overall thought – there are many cases that airborne is possible and *nearly* proven, but long-range aerosol-based transmission is not the dominant mode of SARS-CoV-2 transmission and more of an exception, or there would be higher rates of transmission

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