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Practice Points

A simple method for SARS-CoV-2 RNA detection in the air of an enclosed space

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Over 1 year since the start of the coronavirus disease 2019 (COVID-19) pandemic, routes of transmission of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) are still debated [1]. Most authors consider proximity droplet contamination to be the main route of transmission, with direct or indirect contact appearing to play a lesser role [2]. Airborne transmission is difficult to demonstrate, but is often suggested [3,4]. Recent observations of viral replication in aerosol samples provide additional evidence for this hypothesis [5], and ensuring good ventilation of enclosed spaces is widely recommended in guidelines [6]. Detection of viral RNA in the air could be an indicator of air quality and of the risk of airborne spread of SARS-CoV-2. Devices designed specifically to detect viruses in air samples are expensive and are not generally available in hospitals. Using a bio-collector intended for detection of bacterial and fungal contamination in the air (AIR IDEAL®, bioMérieux, Marcy l'Etoile, France), a simple method of air sampling to detect SARS-CoV-2 RNA in air in an enclosed space was developed; the preliminary results are presented here.

Five-hundred-litre air samples were collected over 5 min and projected by impaction on to a 90-mm Mueller–Hinton agar Petri dish. The medium was swabbed in a standardized quadrangular way, and the swab was placed in standard viral transport medium for testing by reverse transcription polymerase chain reaction (RT-PCR) (GeneXpert®, Cepheid, Sunnyvale, CA, USA). The method was tested in the rooms of all new COVID-19 patients hospitalized in medical wards between 10th April and 6th May 2021, when the alpha strain was dominant. Air samples were taken, where possible, within 48 h of the first positive RT-PCR test. The device was placed >2 m from the patient; patients were asked not to cough and to wear a surgical mask during sampling. All rooms had mechanical air extraction.

Twelve air samples were collected from 10 different patients in 11 different rooms (Table I). SARS-CoV-2 RNA was detected in the air of four rooms, which were occupied by two patients (V and P). Patient P had a 'super-spreader' risk profile; air samples in his room were positive on 3 consecutive days, including 2 days when a window was partially open.

This simple sampling method detected SARS-CoV-2 RNA in the air of the rooms of two of the 10 patients investigated. The distance between the sampling device and the patient was chosen to minimize the chance of interference by droplets. The real-life nature of this study [e.g. patients with different cycle threshold (Ct) values], the small sample size and the unvalidated test method must be taken into account when assessing the results. However, they do appear to support the proposition that there are two patient profiles — non-air excretors/weak air excretors and strong air excretors — as proposed previously [7]. Despite Patient P had

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Table I
Positivity of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) reverse transcription polymerase chain reaction (RT-PCR) tests in patients and their room air samples

Sample/room/patient	Patient positive RT-PCR date	Patient Ct (Etarget/N2target)	Air sampling date	Air Ct (Etarget/N2target)
1/1/V	10/04/2021	14/12	14/04/2021	40/0
2/2/R	15/04/2021	20/21	20/04/2020	0/0
3/3/B	16/04/2021	25/26	20/04/2021	0/0
4/4/E	17/04/2021	32/35	20/04/2021	0/0
5/5//G	18/04/2021	19/22	20/04/2021	0/0
6/6/M	18/04/2021	28/29	20/04/2021	0/0
7/7/D	18/04/2021	25/25	20/04/2021	0/0
8/8//C	27/04/2021	18.8/20.9	29/04/2021	0/0
9/9/P	03/05/2021	25/26	04/05/2021	35.7/37.5
9/9/A	03/05/2021	20.5/22.5	04/05/2021	35.7/37.5
10/10/A	03/05/2021	20.5/22.5	05/05/2021	0/0
11/11/P	03/05/2021	25/26	05/05/2021	43.8/42.8
12/11/P	03/05/2021	25/26	06/05/2021	40/0

Ct, cycle threshold.

moderate Ct values and did not exhibit all of the factors described as increasing aerosol production [7], epidemiological analysis suggests that he may have infected his roommate, Patient A.

Although this work does not demonstrate a link between viral aerosols and risk of transmission, the results do support recommendations for aeration and ventilation of premises to prevent viral transmission [6]. Being able to identify highly excretory patients would also be a benefit, and could even determine the placement of such patients according to the ventilation afforded to different bedspaces.

Since performing this study, the delta variant of SARS-CoV-2 has emerged, which is 40—60% more transmissible than the alpha variant [8]. As more infectious variants emerge, this technology, which is easily implemented and affordable (approximately 30€ per test), could be deployed in systematic testing of hospital environments to identify when enhanced infection prevention measures are indicated.

Detection of viral RNA in the air does not prove that SARS-CoV-2 is transmitted via aerosols. The objective of this study was not to address this, but to investigate a potential indicator (other than CO_2) of the efficiency of the ventilation of premises. If the utility of this method is confirmed by further work, it could be used not just to assess healthcare premises, but also buildings in the private and public sectors.

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