Perspective

CLINICAL INVESTIGATION

In hospitalized COVID-19 patients, face-mask sampling was used to measure the amount of exhaled SARS-CoV-2

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The respiratory pathway is what drives SARS-CoV-2 transmission from person to person, although little is known about the pattern and volume of viral production from exhaled breath. Face-Mask Sampling (FMS), which we have previously demonstrated is capable of detecting exhaled tubercle bacilli, has been modified for use in quantifying exhaled SARS-CoV-2 RNA in patients admitted to hospitals with Coronavirus Disease-2019 (COVID-19).

Human-to-human transmission of the SARS-CoV-2 coronavirus often occurs through the respiratory system. The current gold standard for diagnosing Coronavirus-Disease-2019(COVID-19) is Nasopharyngeal Sampling (NPS), although its utility in identifying contagious people is limited. There is mounting evidence that the virus found in infected patients' exhaled breath plays a crucial role in the spread of SARS-CoV-2. Regarding output quantity and pattern, however, little is known. The detection of influenza virus RNA in respiratory droplets and seasonal coronavirus RNA in aerosols is considerably decreased when face masks are worn by an infected person. Therefore, taking respiratory samples while wearing a face mask, when pathogen emissions are at their peak, may be advantageous. This technique, which we call Face-Mask Sampling (FMS), has been developed by us to identify and measure inhaled microorganisms, first for the research of tuberculosis. In this study, we discuss the application of FMS to hospitalized COVID-19 patients. In patients at various phases of acute infection, we looked into connections between viral load in FMS and NPS and identified correlations with disease severity. In this investigation, we have shown the identification and quantification of SARS-CoV-2 genomes in the exhaled breath of infected patients, of whom one-third were asymptomatic at the time of sampling, utilizing techniques applicable in ordinary clinical and laboratory settings. When active respiratory symptoms were present at the time of sampling and in the first few days after the onset of symptoms, we discovered that patients exhaled viral RNA with a range of over five orders of magnitude. We also discovered that greater FMS viral loads may be associated with more severe illness, in contrast to concurrent NPS viral levels. 38% of those who are known to have COVID-19 have SARS-CoV-2 in their exhaled breath, according to FMS. This is in contrast to the 26.9% positive rate in infected patients that Ma and colleagues reported after utilizing a breath condensate collecting equipment to collect samples for five minutes. We take note of the Ma study's use of a customized sampling tool and the deployment of processing techniques that largely go beyond what is typically available in everyday situations.

Our findings are consistent with Sriraman and colleagues' preliminary research, which used a gelatine sampling matrix to detect a 40% positive rate among FMS-infected people.

Previous research has demonstrated that NPS signals can remain for several weeks even in the presence of index cases that are no longer contagious. Kim and colleagues discovered that the median interval between the onset of symptoms and viral clearance in COVID-19 hospitalized patients was 7 days. In our investigation, no patient had FMS for longer than 10 days after the onset of symptoms. The FMS viral load was highest in patients with early disease (including nosocomial infected patients), and those with active respiratory symptoms at the time of sampling exhaled more virus than those who were asymptomatic.

Given that FMS likely collects a combination of aerosols and larger droplets, most likely from the oropharynx and lower respiratory tract, and depending on concurrent respiratory efforts, vocalization, and respiratory symptom severity, a higher viral load in those who coughed at the time of sampling may reflect this. Additionally, we did not note whether participants spoke during the sampling period, which could have had an impact on the viral load on the FMS.

All things considered, these findings imply that FMS viral load patterns emitted by people may be different from NPS. Future research will examine the connection between SARS-CoV-2 FMS output patterns and transmission to assess the usefulness of this method for identifying an individual's infectivity in comparison to other tests suggested for a similar purpose, such as the lateral flow assays.

Higher FMS viral loads, but not those discovered by NPS, were shown to be substantially correlated with both ISARIC mortality and deterioration scores in multivariable analyses.

The NPS viral load between people with mild, moderate, and severe illness shows little variation, according to other investigations. As the viral load transfers to the lower respiratory tract, NPS-detected viral loads in COVID-19 patients rapidly decline in the upper airways in those with increasing disease severity. Surfactant protein A, which we have previously found in FMS samples, suggests that FMS is likely to capture at least some of its material from the lower respiratory tract.

This characteristic offers a plausible explanation for why, in contrast to NPS, which does not have higher FMS viral loads found here are linked with higher ISARIC scores and subsequently predicted higher illness severity. Despite the need for bigger, more rigorously powered investigations, FMS may play a part in the early detection of those who are at risk of worsening, hospitalization, and mortality.

Face masks are frequently advised for preventing transmission from source patients, and as a result, society has come to accept them. Our approach is low-cost, straightforward, and simple to repeat. Infection control and the early start of life-saving therapy for those who arrive at the hospital could benefit from the potential detection of infected individuals or those who may go on to acquire the serious disease. For instance, as supplementary infection control measures, FMS might be given to patients in the waiting areas of emergency facilities, clinics, or offices, and the PVA strips could be taken out for normal processing in laboratories.

Finally, we propose a novel, clinically acceptable method for detecting and measuring breathed SARS-CoV-2 in hospitalized COVID-19 patients. Exhaled viral load, clinical presentation, and the is most contagious.