



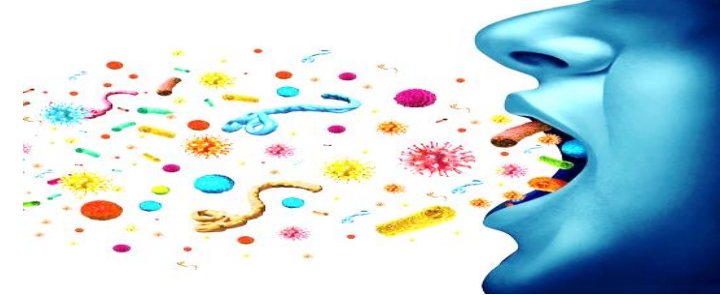
# SARS-CoV-2 emitted in Respiratory Aerosols through Singing, Talking, Breathing



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## BACKGROUND

Multiple SARS-CoV-2 superspreading events suggest that aerosols play an important role in driving the COVID-19 pandemic. However, the detailed roles of coarse ( $>5\mu\text{m}$ ) and fine ( $\leq 5\mu\text{m}$ ) respiratory aerosols produced when breathing, talking, and singing are not well-understood.

### Covid-19: droplet vs airborne transmission

There is debate worldwide over whether the virus is airborne and if this could be a major way it is spread

#### How are respiratory viruses transmitted?

- There are two main modes of transmission
- Via droplets - particles more than 5 to 10 microns in diameter
  - Through the air for smaller particles

#### Droplet transmission

- Happens when someone's mouth, nose or eyes come into contact with respiratory droplets from an infected person.
- These droplets are heavy, do not travel far in the air, and fall to the ground quickly.

#### Airborne transmission

- Here, the virus is present in particles that are so small they can remain suspended in the air for longer, and travel distances greater than 1m.
- Anyone who breathes in the particles becomes infected.

#### Environmental factors

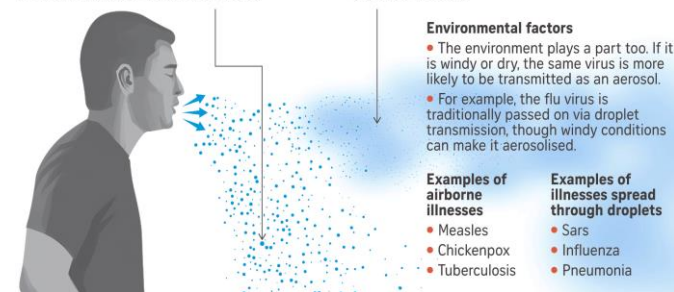
- The environment plays a part too. If it is windy or dry, the same virus is more likely to be transmitted as an aerosol.
- For example, the flu virus is traditionally passed on via droplet transmission, though windy conditions can make it aerosolised.

#### Examples of airborne illnesses

- Measles
- Chickenpox
- Tuberculosis

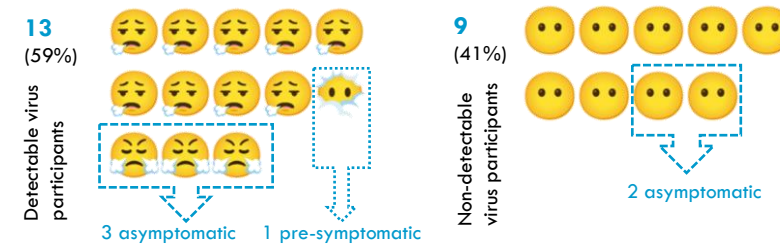
#### Examples of illnesses spread through droplets

- Sars
- Influenza
- Pneumonia



## RESULTS

Among the 22 study participants, 13 (59%) emitted detectable levels of SARS-CoV-2 RNA in respiratory aerosols, including 1 pre-symptomatic patient and 3 asymptomatic patients.



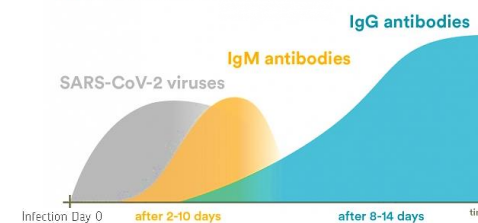
The largest proportion of SARS-CoV-2 RNA copies was emitted by singing (53%), followed by talking (41%) and breathing (6%) - the median number of viral N gene copies generated during singing was 713.6 (IQR 135.1–1216.1), compared to 477.9 (IQR 234.5–1356.6) for talking, and 63.5 (0–227.6) for breathing (Kruskal-Wallis test,  $p=0.026$ ).



COVID-19: When are the virus and antibodies present in the body?

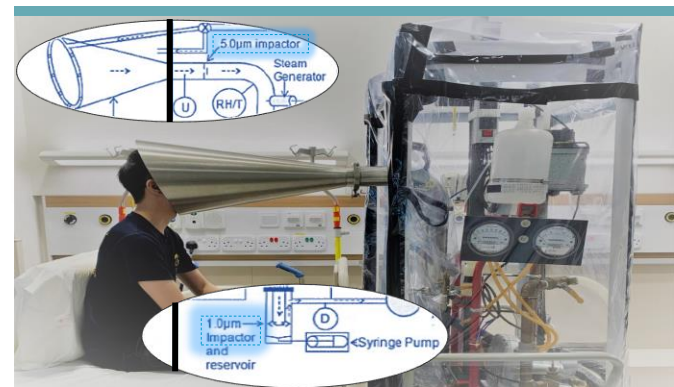
- Viruses in the body: PCR test
- IgM antibodies
- IgG antibodies: lab test

Patients earlier in illness were more likely to emit detectable RNA (median day of illness of 3 versus 5,  $p\text{-value}=0.025$ ). Overall, fine aerosols ( $\leq 5\mu\text{m}$  in diameter) constituted 85.4% of the viral load detected in our study.



## METHODS

Using a Gesundheit-II exhaled breath collector, we measured viral RNA in coarse and fine respiratory aerosols emitted by COVID-19 patients during 30 minutes of breathing, 15 minutes of talking, and 15 minutes of singing.



## CONCLUSION

SARS-CoV-2 can be aerosolized in the absence of coughing, sneezing, and aerosol-generating medical procedures. Fine respiratory aerosols might play an important role in community transmission of SARS-CoV-2, which is in agreement with other expert views suggesting that SARS-CoV-2 transmission is airborne, and could explain the difficulty in containing the virus. The results support calls for proper respiratory protection, airflow patterns, ventilation, filtration, and safe airborne disinfection, particularly in indoor environments, to reduce exposure to SARS-CoV-2 in fine aerosols.

