# Respiratory Droplet Generation and Dispersal During Nasoendoscopy and Upper Respiratory Swab Testing

Vanessa Yee Jueen Tan et al[1]

[1]Affiliation not available

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**Vanessa Yee Jueen Tan** MBBS (S'pore), MRCS (Glasgow), MMed (ORL) Department of Otorhinolaryngology – Head and Neck Surgery Singapore General Hospital

**Edward Zhiyong Zhang** MBBS (S'pore), MRCS (Glasgow), MMed (ORL), MCI, FAMS (ORL) Department of Otolaryngology – Head and Neck Surgery Sengkang General Hospital

**Dan Daniel** PhD Institute of Materials Research and Engineering

**Anton Sadovoy** PhD Institute of Materials Research and Engineering

**Neville Wei Yang Teo** MBBS (S'pore), MRCS (Glasglow), MMed (ORL) Department of Otorhinolaryngology – Head and Neck Surgery Singapore General Hospital

**Kimberley Liqin Kiong** MBBS (S'pore), MRCS (Edinburgh), MMed (ORL), FAMS (ORL) Department of Otorhinolaryngology – Head and Neck Surgery Singapore General Hospital

**Song Tar Toh** MBBS (S'pore), MRCS (Edin), MMed (ORL), MMed (Sleep Med), FAMS (ORL) Department of Otorhinolaryngology – Head and Neck Surgery Singapore General Hospital

**Heng Wai Yuen** MBBS (S'pore), MRCS (Edinburgh), MMed (ORL), DOHNS (England), GDFM Ear Nose Throat, Head and Neck Surgery Changi General Hospital

Corresponding author: Vanessa Yee Jueen Tan vanessa.tan.y.j@singhealth.com.sg

The current COVID-19 pandemic has major implications on the examination of the respiratory tract. Due to the high viral load, there are concerns regarding potential aerosol generation during upper respiratory procedures such as nasoendoscopy and swab testing.[1]Various safety recommendations have been proposed for such procedures.[2,3]

High-speed video with laser light illumination has been used to study respiratory particle dispersal patterns during coughing and sneezing.[4] Here, we used a similar technique to assess respiratory droplet generation and dispersal during nasoendoscopy and swab testing.

## METHODS

The sagittal plane dispersal patterns of respiratory droplets were captured using a digital camera (Panasonic Lumix GH4) at 60 frames per second in a low-airflow light-controlled laboratory. Illumination was provided through a green laser light (535 nm wavelength, 20 mW, 30 centimeter beam-size). To visualize the droplets' trajectories, we combined the relevant frames into one image.

Nasal, nasopharyngeal, and oral swab testing were first performed, followed by nasoendoscopy with and without cophenylcaine spray decongestion, on three volunteers. Manoeuvers performed during nasoendoscopy

included swallow, tongue protrusion, vocalization, cough, and sneeze.

## RESULTS

Video analysis revealed droplet formation only in three manoeuvers during nasoendoscopy – 1) sneezing *(Image 1a),* 2) vocalization*(Image 1b),* and 3) nasal decongestion spray *(Image 1c).* A capillary bridge of mucus was seen when the nasoendoscope exited the wet nares in one volunteer. No droplet formation was demonstrated during oral and nasopharyngeal swab testing.

Video 1a shows the droplets produced when the patient exhales out through the nose following nasal spray. Video 1b shows the droplets produced when the patient sneezes during nasoendoscopy. Video 1a and 1b have been slowed down 12 times. Video 1c shows the droplets produced whilst vocalizing plosives and a cough. There are more droplets seen whilst vocalizing than coughing.

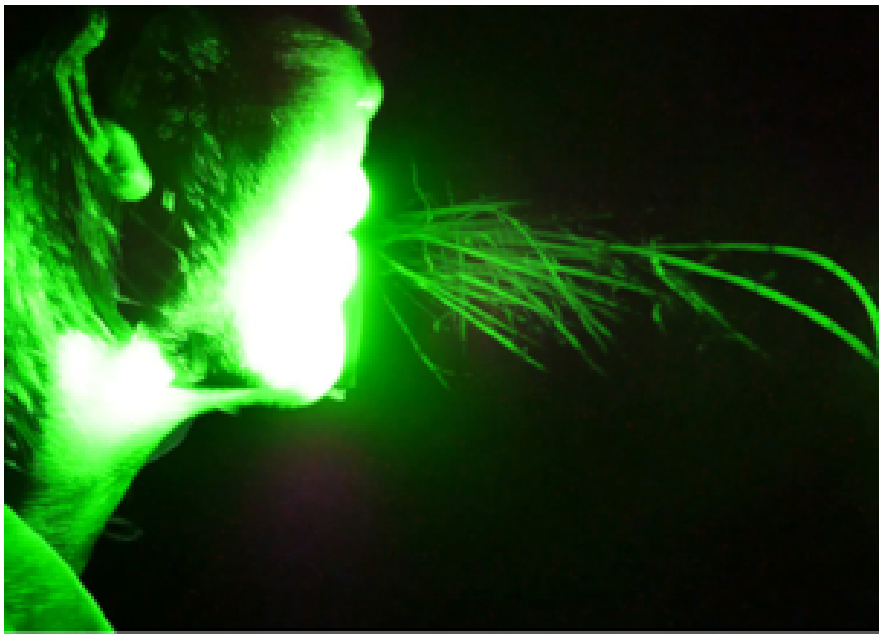
## DISCUSSION

COVID-19 is transmitted through droplet spread, with limited evidence of aerosol spread through droplet nuclei.[5] Polymerase chain reaction testing of nasal, nasopharyngeal, and oropharyngeal swabs remain the gold standard for diagnosis, and is performed worldwide. Nasoendoscopy is a common procedure performed by otolaryngologists. Till date, there has been no definitive evidence of droplet or aerosol generation during nasoendoscopy or upper respiratory tract swabs.

Our study demonstrates that droplets clearly form only under three scenarios during nasoendoscopy. From this, we suggest the following ways to reduce droplet dispersal. Firstly, when only nasal access is required, the face mask should only be pulled down enough to expose the nares. Secondly, while adequate topical nasal decongestion and anesthesia can reduce the tendency of sneezing, nasal sprays are in itself an aerosol generating procedure, and exhalation through the nose during a spray results in large amounts of droplet production. Hence, use of nasal sprays should be avoided if possible, and if used, procedurists should be in full personal protective equipment prior to performing the nasal spray. Patients should be instructed to inhale gently during the spray and avoid immediate exhalation. Adequate time should be given for sufficient anesthesia prior to commencement of nasoendoscopy. Thirdly, droplets formed from speech can be mitigated with the face mask over the patient's mouth. Lastly, withdrawal of the swabs and scope should be performed in a slow and controlled fashion, to reduce potential dispersion of droplets when the capillary bridge of mucus breaks up.

A technical limitation of our study is that our equipment can only adequately assess droplet formation. Aerosols below 10 micrometers (10 μm) are unlikely captured in the images. Studies on aerosol production during similar procedures are ongoing, with the caveat that significant aerosol transmission has yet to be proven in the spread of COVID-19.[5] Nonetheless, this will provide crucial complementary information as aerosols remain suspended in air longer and have a higher risk of penetrating deeper in the airway.[6]

Image 1a – Sneeze



"phe"

Image 1b – Vocalization. Bilabial plosives "*per* " created the most droplets, followed by lingual alveolar plosives "*tee* ", and fricatives "*fer* ". Common sounds patients were often made to elicit during nasoendoscopy such as "eee", tonal glides, and "sniff-hee" maneuver did not produce droplets.

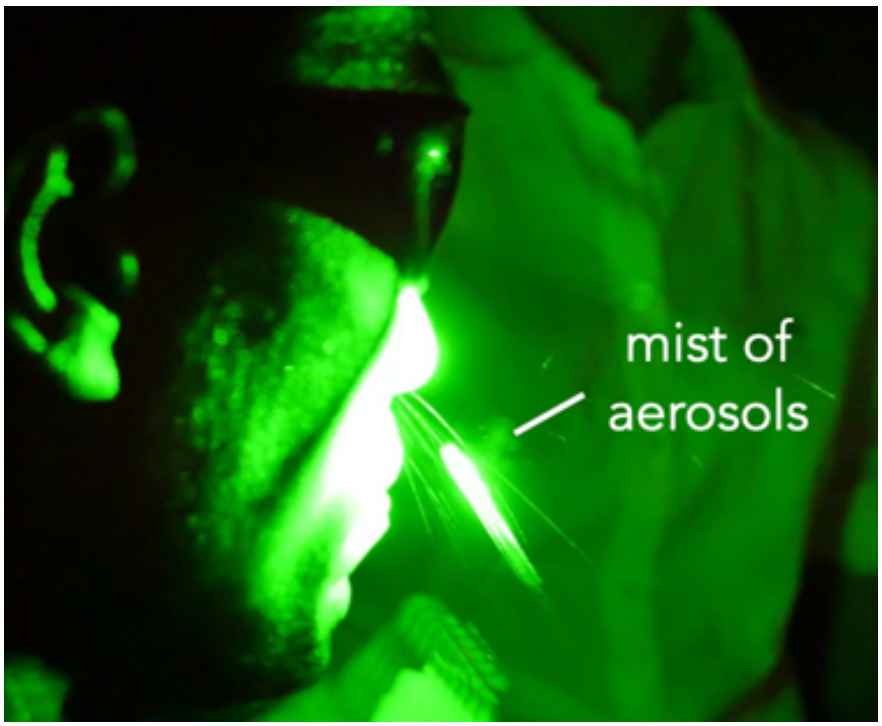



Image 1c – Most droplet production occurred with nasal expiration immediately after nasal decongestion spray

**Videos**

Rich media available at https://youtu.be/ujo9hUgnnMQ

Rich media available at https://youtu.be/a3N8x4SdX_o

Rich media available at https://youtu.be/O0ufpMGE8Gw

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Olympus

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