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**Control of Multi-drug Resistant Organisms in Ambulatory
and Long Term Care Facilities with COVID-19 Pandemic**

Route of Transmission of SARS-CoV-2

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Infection Control Branch
感染控制處

WHO (March 2020)

- Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations: scientific brief (29/3/2020) https://apps.who.int/iris/bitstream/handle/10665/331616/WHO-2019-nCoV-Sci_Brief-Transmission_modes-2020.2-eng.pdf?sequence=1&isAllowed=y

Route of transmission	Size of particle
Respiratory Droplets	>5-10 um
Droplet nuclei	=<5 um

- COVID-19 virus
 - Primarily transmitted through respiratory droplets and contact
 - In an analysis of 75,465 COVID-19 cases in China, airborne transmission was not reported

WHO (March 2020)

- Droplet transmission:
 - 1 meter, mucosae (mouth/nose) or conjunctiva (eyes) exposed to potentially infective respiratory droplets
- Contact transmission:
 - Direct / Indirect contact
- Airborne transmission:
 - In specific circumstances and settings where procedures / support treatment which generate aerosols
 - reports from settings where symptomatic COVID-19 patients have been admitted: no COVID-19 RNA was detected in air samples



WHO (March 2020)

- Droplet and contact precautions for those people caring for COVID-19 patients
- Airborne precautions for circumstances and settings in which aerosol generating procedures, according to risk assessment
- This recommendation is consistent with:
 - Australian Society for Infectious Diseases Limited (ASID) <https://www.asid.net.au/documents/item/1873>
 - Government of Canada <https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals.html>
 - GOV.UK <https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control>

WHO (July 2020)

- WHO - Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations (9/7/2020)
<https://www.who.int/publications/i/item/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations>
- Contact and droplet (within 1 meter) transmission
- Airborne transmission
 - Airborne transmission of SARS-CoV-2 can occur during medical procedures that generate aerosols (aerosol generating procedures).
 - Whether SARS-CoV-2 may also spread through aerosols in the absence of aerosol generating procedures, particularly in indoor settings with poor ventilation



WHO (July 2020)

- Airborne Transmission Theories

- a number of respiratory droplets generate microscopic aerosols (<5 μm) by evaporating, and
- normal breathing and talking results in exhaled aerosols
=> the proportion of respiratory droplets that evaporate to generate aerosols or of exhaled droplet nuclei, and the infectious dose of viable SARS-CoV-2 required to cause infection in another person are not known
- no studies have found viable virus in air samples
- In clinical settings
 - Clinical reports of health workers exposed to COVID-19 index cases, not with aerosol-generating procedures, found no nosocomial transmission when contact and droplet precautions were appropriately used, including the wearing of medical masks => aerosol transmission did not occur in this context.
- In non-healthcare settings:
 - Outside of medical facilities, some outbreak reports related to indoor crowded spaces have suggested the possibility of aerosol transmission, combined with droplet transmission, for example, during choir practice, in restaurants or in fitness classes.
 - Short-range aerosol transmission, particularly in specific indoor locations, such as crowded and inadequately ventilated spaces over a prolonged period of time with infected persons cannot be ruled out.



ECDC (June 2020)

- Transmission of COVID-19
<https://www.ecdc.europa.eu/en/covid-19/latest-evidence/transmission>
- Transmitted from person to person through several different routes
 1. Primarily: respiratory droplets generated by breathing, sneezing, coughing
 2. Contact (direct/indirect)
 3. Airborne: evidence is less robust than the evidence of direct contact transmission



US CDC (Aug 2020)

- COVID-19 Overview and Infection Prevention and Control Priorities in non-US Healthcare Settings
<https://www.cdc.gov/coronavirus/2019-ncov/hcp/non-us-settings/overview/index.html>
- COVID-19 is primarily transmitted from person-to-person through respiratory droplets
- These droplets are released when someone with COVID-19 sneezes, coughs, or talks.
- Infectious droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs.
- A physical distance of **at least 1 meter (3 ft)** between persons is suggested by the World Health Organization (WHO) to avoid infection, although some WHO member states have recommended maintaining greater distances whenever possible¹.
- Respiratory droplets can land on hands, objects or surfaces around the person when they cough or talk, and people can then become infected with COVID-19 from touching hands, objects or surfaces with droplets and then touching their eyes, nose, or mouth.
- Recent data suggest that there can be transmission of COVID-19 through droplets of those with mild symptoms or those who do not feel ill.
- **Current data do not support long range aerosol transmission** of SARS-CoV-2, such as seen with measles or tuberculosis. **Short-range inhalation of aerosols** is a possibility for COVID-19, as with many respiratory pathogens. However, this cannot easily be distinguished from “droplet” transmission based on epidemiologic patterns. Short-range transmission is a possibility particularly in **crowded medical wards** and **inadequately ventilated spaces**. Certain procedures in health facilities can generate fine aerosols and should be avoided whenever possible.



Evidence for Short Range Airborne Transmission

<https://www.hku.hk/press/press-releases/detail/21290.html>

- Prof. Yuguo LI's team from HKU studied 3 outbreaks between Jan to Mar 2020

1. The Guangzhou Restaurant case (occurred on 24 Jan 2020)

- where 9 members from 3 non-associated families sitting in 3 separate tables (A, B and C) were infected by an index patient at table A located in the middle
- 4 people in the same table, 3 people in table B on the left side of A, and 2 people in table C on the right side, were eventually infected
- The 3 families did not know each other and had essentially no contact before, during or after the meal
- The distance between the index patient (A1) and the furthest away infected patron was 4.6 meters



2. Buses Case (22 Jan 2020)

- An index patient took 2 buses subsequently from [Changsha](#) to his home village in an afternoon and eventually infected 10 passengers in total
- The 1st leg of the journey involved a bus with 46 other people (passengers/driver): the 3 hours 20 minutes' ride resulted in 7 passengers being infected (~15%)
- The 2nd journey on a minibus lasting about an hour: 2 out of 17 other people (passengers, driver and conductor) were infected (~11.8%)
- Distance between the index patient (A1) and furthest away infected patron was 9.5 meters
- The ventilation rate:
 - in the bus: 1.7L/s
 - In the minibus: 3.2L/s
 - Infection distribution consistent with a spread pattern representative of exhaled virus-laden aerosols => infection rate in minibus is lower

3. Diamond Princess Cruise (March 2020)

- A total of 696 confirmed cases (552 passengers and 144 crew members, of those 410 were asymptomatic) were reported by 5 Mar 2020 among the 2,666 passengers undergoing quarantine in their staterooms and 1,045 crew members on board the ship
- The team analyzed the daily records of 197 of the 286 symptomatic infected cases (149 passengers and 48 crew) when quarantine ended on 16 Feb 2020
- It is found infection among passengers after the onset of quarantine on 6 Feb 2020 was limited to those stayed in the same stateroom with an infected passengers
- Other cases were infected before the quarantine period
 - ⇒ Central air conditioning system in the staterooms did not play a role in the disease's transmission (ie no long-range airborne transmission between staterooms can be identified)
 - ⇒ ISO 7547: 2004: ventilation requirement for the cruise 8L/s per person

Conclusion from studies of the three scenarios and Recommendation

• Conclusion

- Air borne transmission of COVID-19 in the indoor environments likely when the ventilation rate is less than 3L/s per person with a sufficient exposure period
- Ventilation rates of 8-10L/s per person, similar to that on the cruise, sufficient for minimizing airborne infection risk

• Recommendation

- To enhance air ventilation in indoor environments particularly in restaurants, public transport, bars, gyms
- An indoor venue for heavy activities needs a higher ventilation rate than those for normal activities.
- Avoid social gatherings in an indoor environment where sufficient ventilation is not provided
- Installation of CO2 sensors in a room can be useful (concentration of over 1000 ppm may indicate that the room is not sufficiently ventilated)



A Choir Decided to Go Ahead with Rehearsal

- <https://www.latimes.com/world-nation/story/2020-03-29/coronavirus-choir-outbreak> (29Mar 2020 LA Times)
- Now dozens of members have COVID-19 and 2 are dead
- Choir rehearsal on 10 Mar 2020
- 61 singers showed up with social distancing for 2.5 hours (no hugs/ no handshakes)
=> 33 infected, 2 died (super-spreading event)
- **Inadequate ventilation. Long exposure.**
- Particles smaller than 5 um can float in the air for minutes or longer
- Project your voice would project more droplets and aerosols
- People happen to be especially good at exhaling fine material, producing 1,000 times more than others



Nosocomial Outbreak of Coronavirus Disease 2019 by Possible Airborne Transmission Leading to a Superspreading Event

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Background. Nosocomial outbreaks with superspreading of coronavirus disease 2019 due to a possible airborne transmission have not been reported.

Methods. Epidemiological analysis, environmental samplings, and whole-genome sequencing (WGS) were performed for a hospital outbreak.

Results. A superspreading event that involved 12 patients and 9 healthcare workers (HCWs) occurred within 9 days in 3 of 6 cubicles at an old-fashioned general ward with no air exhaust built within the cubicles. The environmental contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) RNA was significantly higher in air grilles (>2 m from patients' heads and not within reach) than on high-touch clinical surfaces (36.4%, 8 of 22 vs 3.4%, 1 of 29, $P = .003$). Six (66.7%) of 9 contaminated air exhaust grilles were located outside patient cubicles. The clinical attack rate of patients was significantly higher than of HCWs (15.4%, 12 of 78 exposed patients vs 4.6%, 9 of 195 exposed HCWs, $P = .005$). Moreover, the clinical attack rate of ward-based HCWs was significantly higher than of nonward-based HCWs (8.1%, 7 of 68 vs 1.8%, 2 of 109, $P = .045$). The episodes (mean \pm standard deviation) of patient-care duty assignment in the cubicles was significantly higher among infected ward-based HCWs than among noninfected ward-based HCWs (6.0 ± 2.4 vs 3.0 ± 2.9 , $P = .012$) during the outbreak period. The outbreak strains belong to SARS-CoV-2 lineage B.1.36.27 (GISAID clade GH) with the unique S-T470N mutation on WGS.

Conclusions. This nosocomial point source superspreading event due to possible airborne transmission demonstrates the need for stringent SARS-CoV-2 screening at admission to healthcare facilities and better architectural design of ventilation systems to prevent such outbreaks. Portable high-efficiency particulate filters were installed in each cubicle to improve ventilation before resumption of clinical service.

Keywords. COVID-19; hospital outbreak; airborne transmission; ventilation system; whole genome sequencing.

Downloaded from https://academic.oup.com/cid/advance-article-abstract/doi/10.1093/cid/ciaa1000/5811111 by University of Hong Kong user on 12 November 2020

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SCIC paper: Transmission of SARS-COV-2: Implication for IC Measures May 2021

Short-Range Airborne Transmission in Poorly Ventilated Enclosed Environment

- infected cases tend to occur mostly within the range of several meters
- no definite evidence of efficient airborne transmission over long ranges (>10m) analogous to other highly transmissible infectious diseases such as measles and varicella.



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Scientific Committee on Infection Control
Transmission of SARS-CoV-2: implications for infection control measures

Introduction

Coronavirus disease 2019 (COVID-19) has great impact to Hong Kong and the world. It is caused by a new coronavirus related to SARS-CoV and is termed SARS-CoV-2. During the outbreak, many clusters of infections occurred in different confined environments. The mode of transmission in these environmental conditions has significant implication on the advice on infection control practice including personal protective equipment (PPE) required and environmental control for this novel infection. This paper sets out the scientific evidence to critically appraise on the issue of short-range airborne transmission of COVID-19 in poorly ventilated enclosed environment, and provides recommendation on the infection control measures to be adopted.

Global & Local Situation of COVID-19

2. COVID-19 was first reported to the World Health Organization (WHO) on 31 December 2019, followed by rapid and wide scale international spread. WHO declared COVID-19 as a pandemic on 11 March 2020. As of 13 May 2021, there have been 160,074,267 confirmed cases of COVID-19, including 3,325,260 deaths worldwide. There is currently about 745,256 new cases reported daily, with a majority from the Indian subcontinent [1] Locally, as of 13 May 2021, there have been 11,818 confirmed/probable cases with 210 deaths related to COVID-19 according to the Centre for Health Protection of the Department of Health. [2] As a result, a huge demand on isolation rooms in public hospitals, community treatment facilities, and quarantine centres, quarantine hotels, home quarantine are needed. Demand for PPE especially for surgical masks and respirators remains a challenge.





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Dispatch

Epidemiologic Evidence for Airborne Transmission of SARS-CoV-2 during Church Singing, Australia, 2020

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[Cite This Article](#)

Abstract

An outbreak of severe acute respiratory syndrome coronavirus 2 infection occurred among church attendees after an infectious chorister sang at multiple services. We detected 12 secondary case-patients. Video recordings of the services showed that case-patients were seated in the same section, up to 15 m from the primary case-patient, without close physical contact, suggesting airborne transmission.

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Thank you!