



online ISH seminar 23-03-21

IAQ and the role of ventilation during the pandemic

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Indoor Air Quality (IAQ)

Definition EPA:

see: <https://www.epa.gov/indoor-air-quality-iaq>

- *‘Indoor Air Quality (IAQ) refers to the air quality within buildings, especially as it relates to the health and comfort of building occupants. Understanding and controlling common pollutants indoors can help reduce your risk of indoor health concerns.’*

IAQ ≠ IEQ:

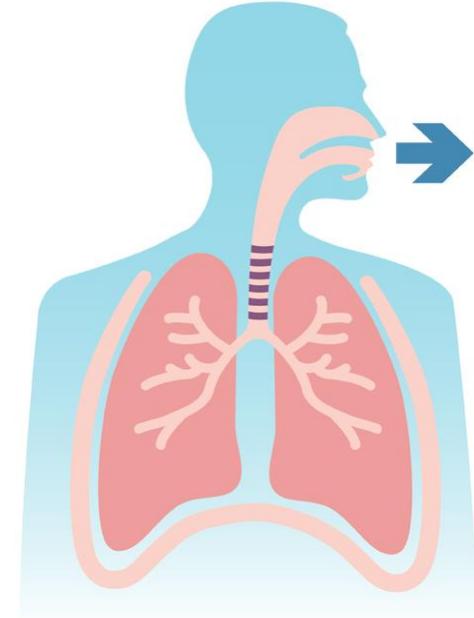
- IEQ = Indoor Environmental Quality = container concept that includes
 - i. indoor air quality,
 - ii. thermal environment,
 - iii. light and
 - iv. acoustics



INTERNATIONAL SOCIETY OF
INDOOR AIR QUALITY
AND CLIMATE

IAQ aspects

- Volatile organic compounds (e.g. Formaldehyde)
- Semi-volatile organic compounds (e.g. Phthalates)
- Combustion products (CO, NO₂, SO₂)
- Ozone
- Particles (incl. ultrafine particles)
- Man made mineral fibres (incl. asbestos)
- Radon
- Molds and other allergens
- Bacteria (e.g. Legionella)
- CO₂ and other 'bio-effluents'
- **Viruses (e.g. Influenza, COVID)**



*The average person inhales about
10 m³ of air each day*

IAQ effects on people

- Allergies
- Other immune system effects
- Lung cancer
- Skin, eye, nose, throat irritation
- Nervous system effects (e.g. headaches)
- Cardiovascular system effects
- Decreased productivity / learning performance
- **Infectious diseases**



source: <https://www.inive.org>

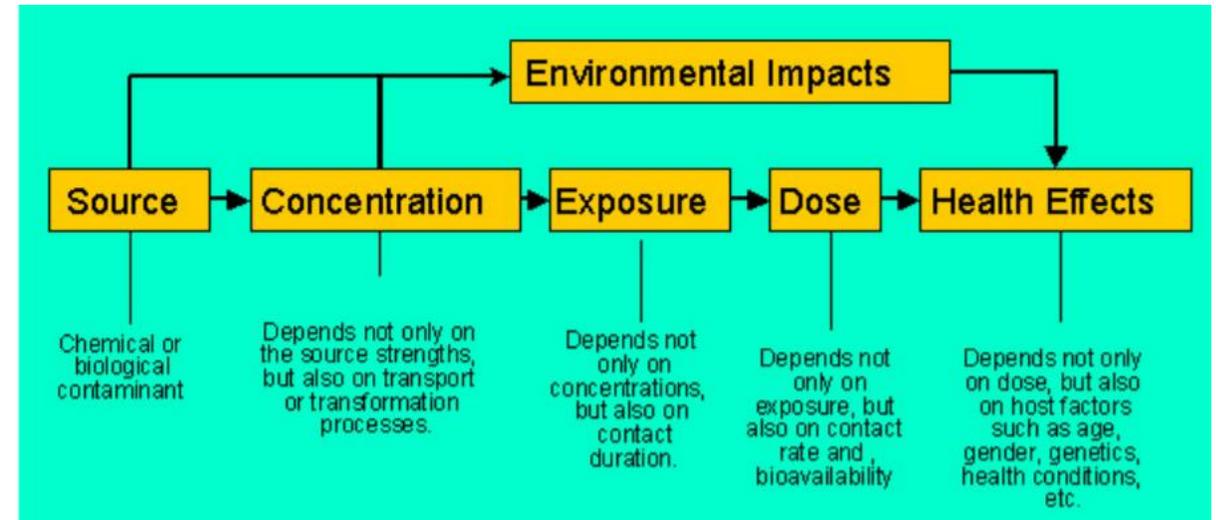
IAQ & ventilation

Good IAQ = good ventilation?

- **NO!** (it is more complex than that...)

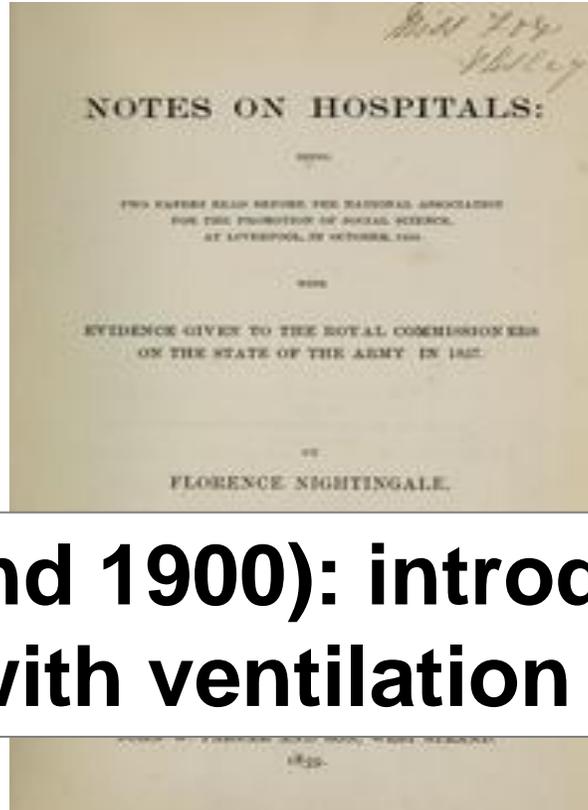
Indoor exposure is affected by esp.:

- **Source strength**
- **Exposure time / dose**
- **Ventilation**
(via natural and/or mechanical means)
- **Filtration**
(use of HVAC system filters, separate air cleaning devices, masks)



Air pollution system as defined by Zhang & Liou, 2002

Historical context: Florence Nightingale



Environmental theory:

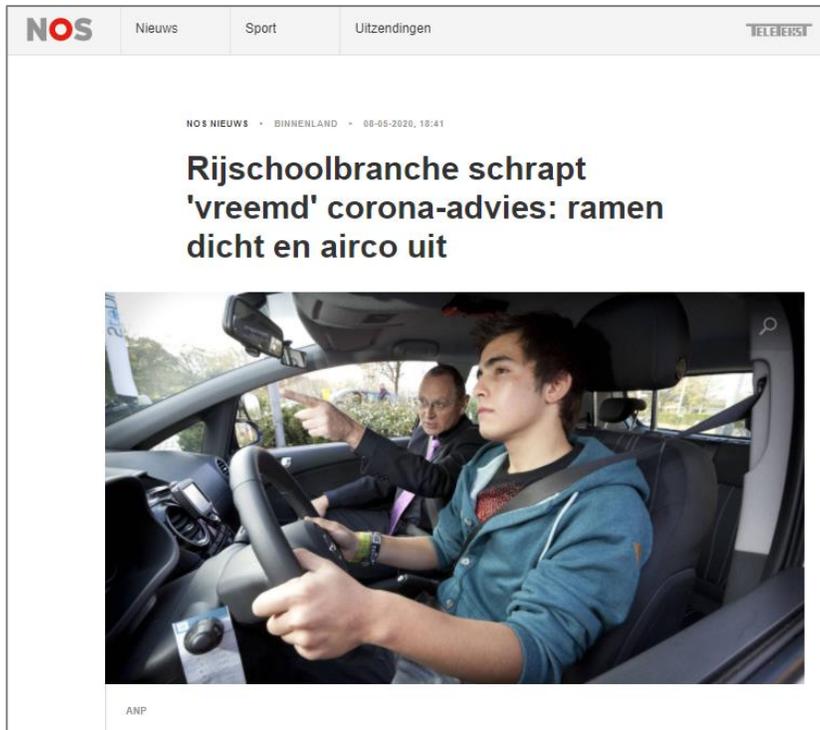
“Essential components of a healthy environment:

- *fresh air*
- *pure water*
- *efficient drainage*

Effect (around 1900): introduction of building codes with ventilation requirements

source: Nightingale, 1859

Intermezzo: 'clever' driving school advice

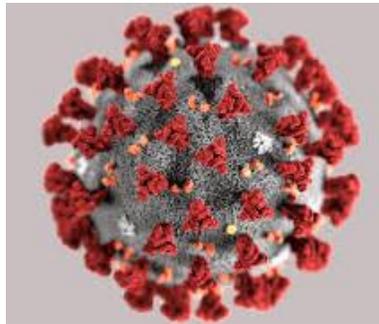


benauwdheidsklachten?

- De instructeur dient voorafgaand aan elke les dezelfde vragen te stellen aan de leerling. Worden hier beide vragen met 'nee' beantwoord, dan kan de les starten.
- Tijdens de les is de airco en luchtventilatie zoveel mogelijk uit houden en blijven ramen zoveel mogelijk gesloten om luchtcirculatie tegen te gaan. *UPDATE 11 mei: deze regel is geschrapt.*
- Voorafgaand aan elke les wordt het voertuig gedesinfecteerd en gelucht (Voor dit desinfecteren en luchten komt een checklist, afgeleid van het protocol).

‘During lessons the car’s airco and ventilation system should be turned off’; *update may 11th: this measure does not apply anymore*

Fast forward 2020: China buddhist bus case



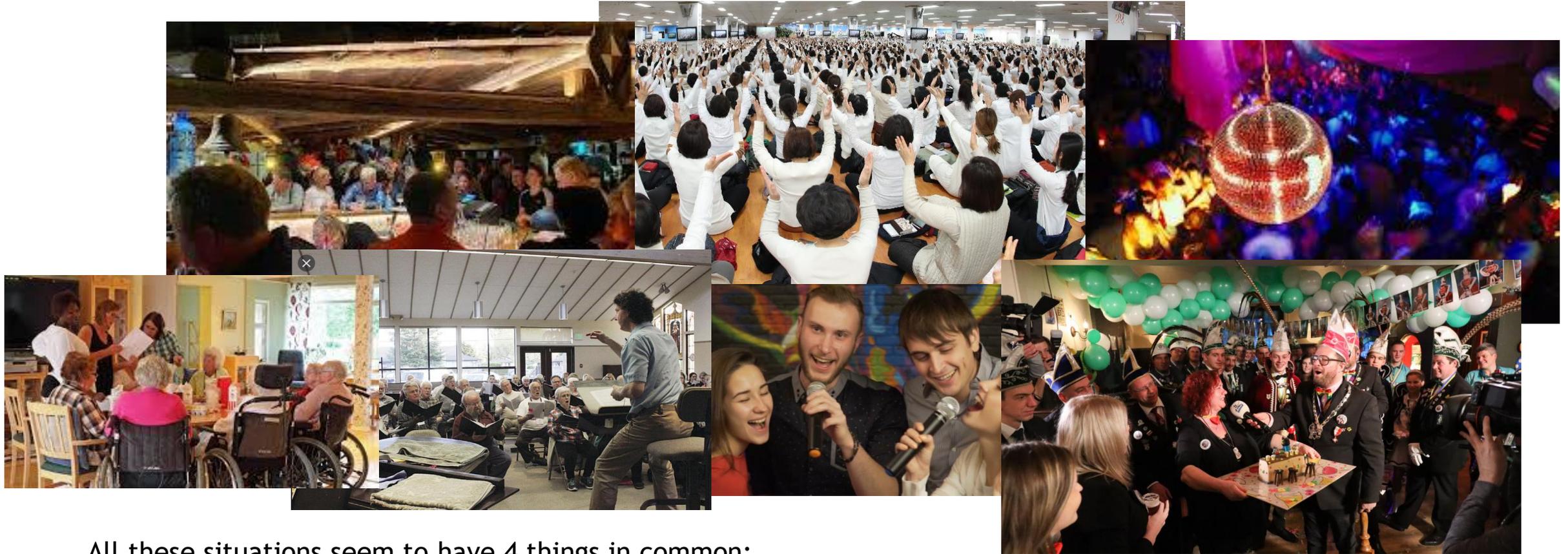
COVID-19



One person infects 18 others during a bus ride in 2 x 50 minutes (!);
probable cause: *insufficient ventilation / system in recirculation mode*

Source: Shen et al, 2020

Examples of COVID-19 Super Spreading Events



All these situations seem to have 4 things in common:

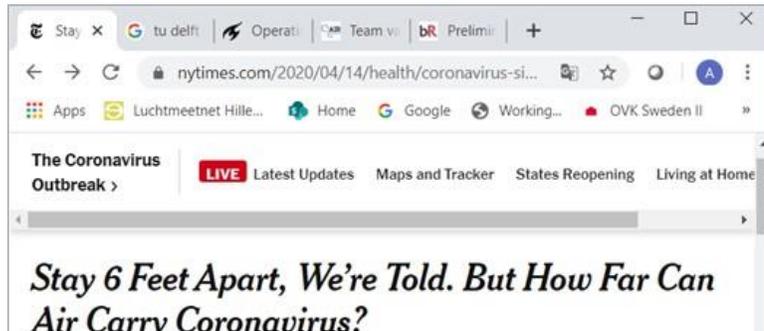
1. *crowding* 2. *small/medium sized spaces* 3. *mediocre fresh air supply* 4. *lots of talking, shouting, singing*

Outcomes SSE database analysis august 2020



(Boerstra et al., unpublished results)

Aerosols / airborne route really important?



Stay 6 Feet Apart, We're Told. But How Far Can Air Carry Coronavirus?

Most of the big droplet: the "trillion-dollar ques



Covid-19: Airborne transmission is being underestimated, warn experts

Owen Dyer

Microscopic respiratory droplets generated by talking and breathing can hover in the air for minutes or hours and drift many metres horizontally before infecting people, argue 239 experts from 32 countries, in a commentary published in *Clinical Infectious Diseases*.¹

"We appeal to the medical community and to the relevant national and international bodies to recognise the potential for airborne spread of covid-19," wrote the scientists, who include physicians, epidemiologists, and experts in environmental health and building design.

"Studies by the signatories and other scientists have demonstrated beyond any reasonable doubt" that airborne droplets can pose a risk beyond 2 m from an infected person, the authors argued. They cited the

Feature

Mounting evidence suggests that coronavirus can travel in airborne aerosols – but health advice has been slow to catch up. By Dyani Lewis



"Hand washing is always a good measure," says the aerosol scientist, who works at the Queensland University of Technology. But the sign might be outdated.

that waft through the air and accumulate over time. After months of debate about whether people can transmit the virus through exhaled air, there is growing concern among scientists

transmission. It maintains that more research is needed "given the possible implications of such [a] route of transmission", but acknowledges that short-range aerosol transmission

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Sources: NY Times, Nature, British Medical Journal (original source: Morawska & Milton, 2020)

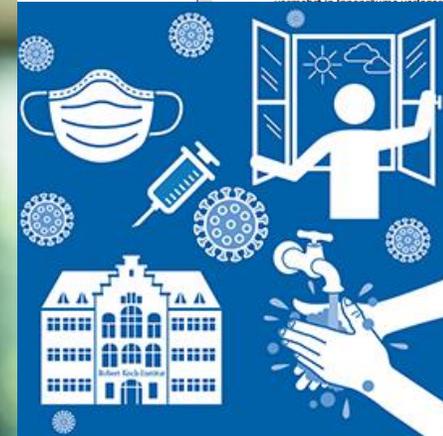
Last autumn, in Germany

Angela Merkel (with reference to Christian Dorsten):

Wir werden auch ein Schwerpunkt auf das Thema Lüftung setzen, denn bei Corona eine grosse



sources:



Position European Centre for Disease Control

‘HVAC systems may have a complementary role in decreasing transmission in indoor spaces by increasing the rate of air change, decreasing recirculation of air and increasing the use of outdoor air.’

‘When it is not possible to measure the ventilation rate, measuring carbon dioxide air levels can be considered. Technical guidelines recommend that the carbon dioxide concentration is kept below 800 to 1 000 ppm to ensure sufficient ventilation.’

see: www.ecdc.europa.eu



Heating, ventilation and air-conditioning systems in the context of COVID-19: first update

10 November 2020

Key messages

- It is now well-established that COVID-19 transmission commonly occurs in closed spaces;
- If well-maintained and adapted for use in the COVID-19 pandemic, heating, ventilation and air-conditioning (HVAC) systems may have a complementary role in decreasing potential airborne transmission of SARS-CoV-2;
- Four bundles of non-pharmaceutical interventions (NPIs) should be considered to reduce potential airborne transmission of SARS-CoV-2 in closed spaces: the control of COVID-19 sources in closed spaces; engineering controls in mechanically ventilated (by HVAC systems) and naturally ventilated closed spaces; administrative controls; and personal protective behaviour.

Scope of this document

This document provides guidance on heating, ventilation and air-conditioning (HVAC) systems in closed spaces in the context of the COVID-19 pandemic.

Changes to the current update

The first update of the ECDC ventilation guidance document contains:

- key new findings that emphasise four bundles of NPIs to reduce the risk of SARS-CoV-2 transmission in closed spaces;
- updated references on the evidence of ventilation in closed spaces;
- recommendations based on the new evidence and on national and international guidance; and
- an overview of national guidance documents in the context of COVID-19 based on an inquiry sent to ECDC's National Focal Points (NFPs) for Preparedness and Response and NFPs for Influenza and other respiratory diseases.

Target audience

Public health authorities in the European Union and European Economic Area (EU/EEA) and the United Kingdom (UK).

Suggested citation: European Centre for Disease Prevention and Control. Heating, ventilation and air-conditioning systems in the context of COVID-19. 10 November 2020. Stockholm: ECDC, 2020.
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Position World Health Organisation march 2021

‘The risk of getting COVID-19 is higher in crowded and inadequately ventilated spaces...’

‘Understanding and controlling building ventilation can (...) reduce the risk of indoor health concerns and prevent the virus that causes COVID-19 from spreading indoors.’

‘Minimum recommended ventilation rate: 10 l/s per person.’

World Health Organization

Roadmap to improve and ensure good indoor ventilation in the context of COVID-19

REHVA 3E

6.2 Non-residential settings

natural ventilation		
Minimum requirements	Steps - key questions	Strategies
Minimum recommended ventilation rate: +10 L/s/person (EN 18798-1) (42, 43)	Does the ventilation rate meet the minimum requirement? To estimate the ventilation rate consult point 2.	<p>Assess the opening location and opening surface considering potential new openings (additionally window or door dimensions).</p> <p>Enable cross ventilation, if not yet present, instead of single-sided ventilation. Keep the doors open to allow air movement.</p>  <p>→ The use of a pedestal fan placed close to an open window could enable ventilation.</p> <p>→ Installation of air extractors or whirlybirds (33); building works to improve stack effect of other natural ventilation strategies.</p> <p>If no other strategy can be adopted, consider using a stand-alone air cleaner with MERV 14/F8 filters (44). The air cleaner should be positioned in the areas used by people and close to people. Air cleaner capacity should at least cover the gap between the minimum requirement and the measured ventilation rate - compare the device clean air delivery rate (CADR) (m³/hr) with the room ventilation rate. Note: Consider that filtered recirculated air does not replace ventilation in any circumstance.</p> <p>The use of fans and/or fan coil or split units for cooling and heating as well as ceiling fans increase the air mixing within the room or the space (44). This strategy should be implemented only if the minimum ventilation rate has been met.</p>  <p>Open the windows to allow proper ventilation before and after occupied times. Windows should be opened for approximately 15 minutes when entering the room (especially when the room was occupied by others beforehand) (37).</p> <p>In collaboration with a HVAC professional, if the device is equipped with filters, consider replacing existing air filters with MERV 14/F8 or the highest compatible with the filter rack. Make sure the units can overcome the additional pressure drop of the new filters. Note: Consider that non-ducted recirculating units do not replace ventilation in any circumstance.</p> <p>Air-conditioning and heating units performed by split system and fan coil units should be periodically cleaned and maintained. Filters should also be periodically cleaned or changed. Note: Consider that non-ducted recirculating units do not replace ventilation in any circumstance.</p>
	NO	NO
	YES	YES
		NO
		END

source: <https://www.who.int/publications/i/item/9789240021280>

Conclusions



- COVID-19 super spreading events seem to happen especially in underventilated indoor spaces
- Several studies have shown that COVID-19 (also) can be transmitted via aerosols, over distances >> 2m
- Ventilation matters (but more is needed to achieve healthy and safe indoor air, AHA+L approach)
- Fortunately, ventilation is now on the (WHO/ECDC/RKI etc) agenda as one of the mitigating measures