Managing and Monitoring Air Quality in Ortigas

Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- COVID-19 Transmission
- COVID-19 & Air Quality
- Building Forward Better

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH

Heal and Transform Lives

Beyond Six Feet:

Transmission and Prevention of COVID-19 in Indoor Settings

GEMINN LOUIS C. APOSTOL, MD, MBA

Head Environmental Health Specialist, Ateneo School of Medicine and Public health
Scientific Expert, Philippine Inter-agency Committee on Environmental Health (IACEH)
Private Sector Specialist, ThinkWell LLC

Transmission and Prevention of COVID-19 in Indoor settings

- ► **Preliminaries**
- ► COVID-19 Transmission
- ► COVID-19 & Air Quality
- ► Building Forward Better

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH

Heal and Transform Lives

Some important caveats

The science around COVID-19 exposure, transmission, and pathogenesis is **constantly evolving**

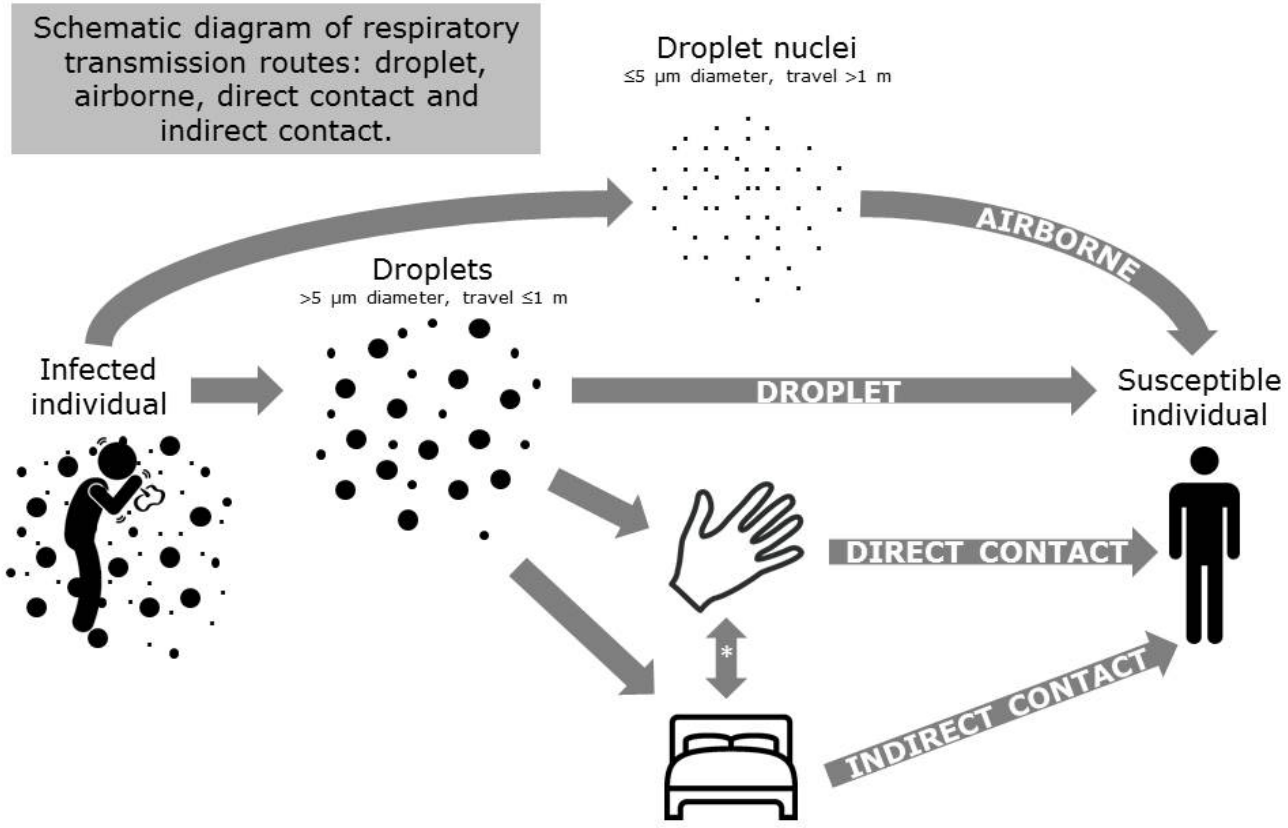
Transmission (and prevention) is **multi-factorial and not definite**. No single measure, by itself, is effective. An optimal mix of cost-effective measures is warranted

Efforts on mitigating and preventing transmission of COVID-19 must be **evidence-based, but also adaptive**.

Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- **COVID-19 Transmission**
- COVID-19 & Air Quality
- Building Forward Better

The strongest evidence on COVID-19 transmission is by exposure to respiratory droplets carrying SARS COV-2



* Transmission routes involving a combination of hand & surface = indirect contact.

Definition of 'Droplet' and 'Droplet nuclei' from Annex C: Respiratory droplets, in Natural Ventilation for Infection Control in Health-Care Settings, Atkinson J., et al., Editors. 2009: Geneva.

* These modes of transmission are not mutually exclusive.

* Asymptomatic transmission is possible

NOTE: The science on COVID-19 transmission is constantly evolving. Please continue to reconcile the content of this slide with the latest, reliable evidence

Transmission and Prevention of COVID-19 in Indoor settings

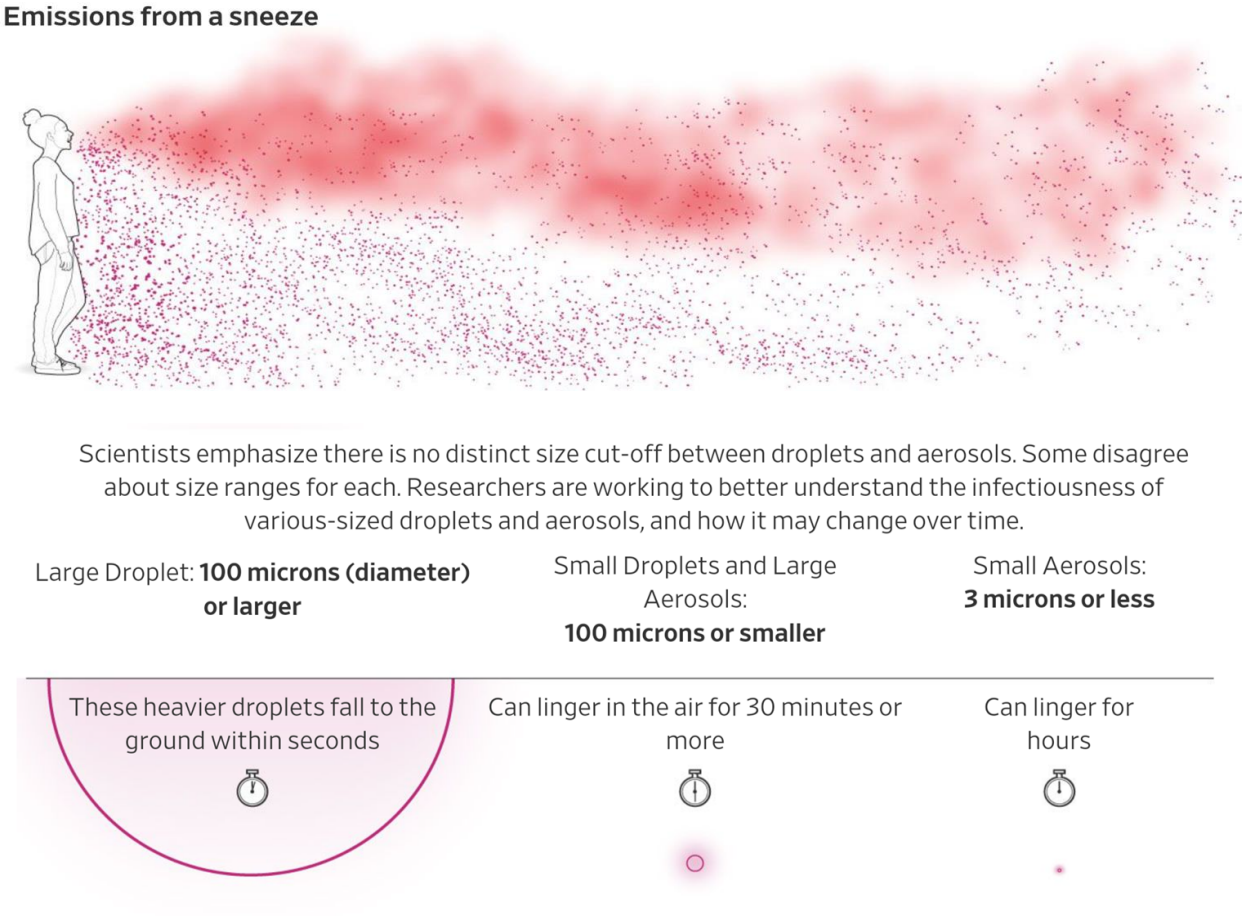
- Preliminaries
- COVID-19 Transmission
- **COVID-19 & Air Quality**
- Building Forward Better

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH
Heal and Transform Lives

Epidemiologic considerations and implications of airborne transmission of COVID-19

World Health Organization

"Airborne transmission of the virus can occur in health care settings through aerosol generating medical procedures. Some **outbreak reports related to indoor crowded spaces have suggested the possibility of aerosol transmission**, combined with droplet transmission"



NOTE: The science on COVID-19 transmission is constantly evolving. Please continue to reconcile the content of this slide with the latest, reliable evidence

Transmission and Prevention of COVID-19 in Indoor settings

- ► Preliminaries
- ► COVID-19 Transmission
- ► **COVID-19 & Air Quality**
- ► Building Forward Better

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH
Heal and Transform Lives

There is available (and growing) evidence on airborne transmission of SARS-CoV-2 through aerosols

(updated as of October 23, 2020)

Epidemiological Evidence Suggestive of Transmission Through Aerosol

- Hamner et al. *High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice — Skagit County, Washington*, March 2020. MMWR Morb Mortal Wkly Rep 2020 May 15;69(19)606-610.
- Li et al., *Evidence for probable aerosol transmission of SARS-CoV-2 in a poorly ventilated restaurant*. EXIT
- Miller et al. 2020. *Transmission of SARS-CoV-2 by inhalation of respiratory aerosol in the Skagit Valley Chorale superspreading event.* Indoor Air. medRxiv preprint doi: this version posted June 18, 2020. EXIT
- Brlek et al. 2020. **Possible indirect transmission of COVID-19 at a squash court, Slovenia, March 2020: case report.** Epidemiology and Infection 148, e120, 1–3.
- Shen et al. 2020. *Airborne transmission of COVID-19: epidemiologic evidence from two outbreak investigations.* DOI.EXIT
- Park et al. 2020. *Early Release-Coronavirus Disease Outbreak in Call Center, South Korea.* Emerging Infectious Diseases, 26:8.EXIT
- Morawska et al. 2020. *How can airborne transmission of COVID-19 indoors be minimized?* Environ Int. PMID 32521345.
- Anderson et al. 2020. ***Consideration of the Aerosol Transmission for COVID-19 and Public Health***. Risk Analysis.
- Morawska and Milton. *It is Time to Address Airborne Transmission of COVID-19,* Clinical Infectious Diseases , ciaa939. EXIT
- Allen and Marr. 2020. ***Re-thinking the Potential for Airborne Transmission of SARS-CoV-2.***
- Tellier et al. 2019. ***Recognition of aerosol transmission of infectious agents: a commentary.*** BMC infectious diseases, 19(1), 101.

Reports of Measurements in Aerosols

- van Doremalen et al. ***Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1.*** The New England journal of medicine, 2020; 382: 1564-7.
- Santarpia et al. 2020. ***Transmission potential of SARS-CoV-2 in viral shedding observed at the University of Nebraska Medical Center***.medRxiv 2020.03.23.20039446; doi:
- Chia et al. 2020. ***Detection of air and surface contamination by SARS-CoV-2 in hospital rooms of infected patients***. Nature communications, 11(1), 1-7.
- Nissen et al. 2020. *Long-distance airborne dispersal of SARS-CoV-2 in COVID-19 wards.* EXIT
- Fears et al. ***Persistence of severe acute respiratory syndrome coronavirus 2 in aerosol suspensions.*** Emerg Infect Dis. 2020 S
- Guo et al. 2020. Early Release - ***Aerosol and Surface Distribution of Severe Acute Respiratory Syndrome Coronavirus 2 in Hospital Wards, Wuhan, China,*** Volume 26, Number 7—July 2020 - Emerging Infectious Diseases journal - CDC. doi:10.3201/eid2607.20088
- Ong et al. 2020. ***Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient.*** JAMA, 323(16), 1610-1612. doi:10.1001/jama.2020.3227
- Zhou et al. 2020. ***Investigating SARS-CoV-2 surface and air contamination in an acute healthcare setting during the peak of the COVID-19 pandemic in London.*** Published by Oxford University Press for the Infectious Diseases Society of America.

Modelling of aerosol dynamics

- Liu et al. 2017. ***Short-range airborne transmission of expiratory droplets between two people.*** Indoor Air. 27:452-462
- Riediker and Tsai. 2020. ***Estimation of SARS-CoV-2 emissions from non-symptomatic cases.*** medRxiv.
- Buonanno et al. 2020. ***Estimation of airborne viral emission: quanta emission rate of SARS-CoV-2 for infection risk assessment***. Environment International, 105794.
- Qian and Zheng. 2018. ***Ventilation control for airborne transmission of human exhaled bio-aerosols in buildings.*** J Thorac Dis. 2018;10(S9):S2295-S2304. doi:10.21037/jtd.2018.01.24.

The current, known epidemiology of SARS-CoV-2 indicates that **most infections are still spread through close contact**, not airborne transmission

NOTE: The science on COVID-19 transmission is constantly evolving. Please continue to reconcile the content of this slide with the latest, reliable evidence

Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- COVID-19 Transmission
- **COVID-19 & Air Quality**
- Building Forward Better

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH
Heal and Transform Lives

There is available (and growing) evidence on airborne transmission of SARS-CoV-2 through aerosols

(updated as of October 23, 2020)

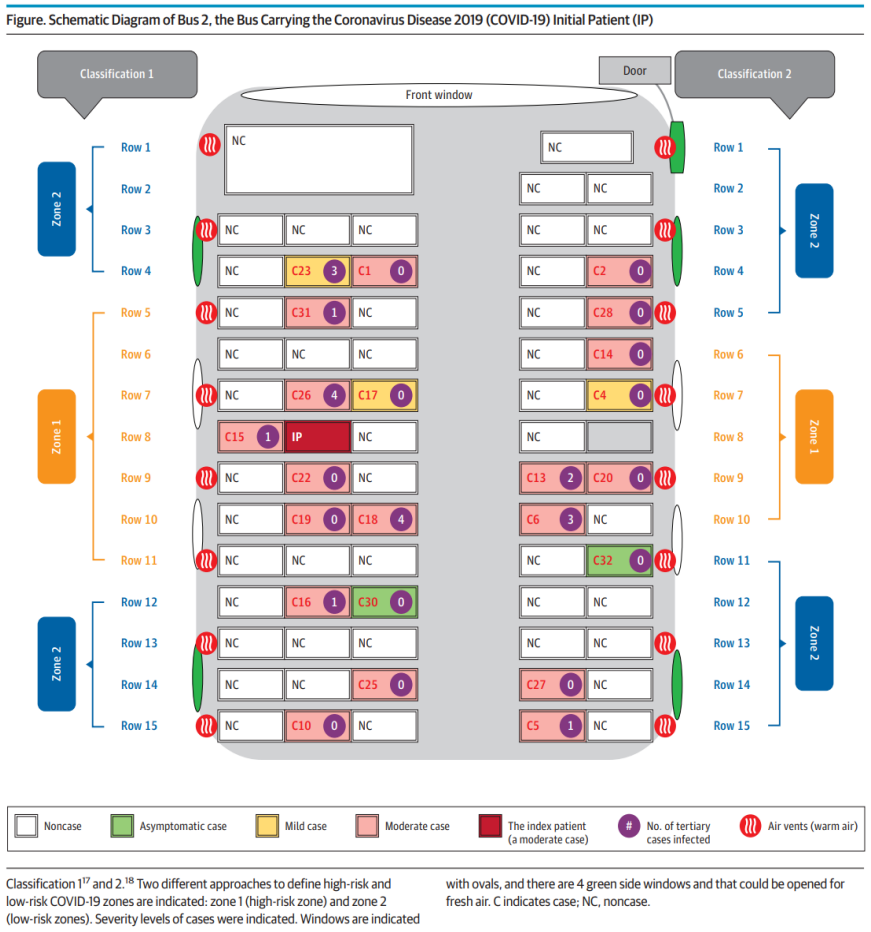


Figure. Schematic Diagram of Bus 2, the Bus Carrying the Coronavirus Disease 2019 (COVID-19) Initial Patient (IP)

Classification 1[17] and 2.[18] Two different approaches to define high-risk and low-risk COVID-19 zones are indicated: zone 1 (high-risk zone) and zone 2 (low-risk zones). Severity levels of cases were indicated. Windows are indicated with ovals, and there are 4 green side windows and that could be opened for fresh air. C indicates case; NC, noncase.

[Community Outbreak Investigation of SARS-CoV-2 Transmission Among Bus Riders in Eastern China]

"In an **enclosed bus with recirculating air conditioning**, even passengers sitting more than 2 meters or three rows away from the index case developed COVID-19 suggesting airborne transmission"

NOTE: The science on COVID-19 transmission is constantly evolving. Please continue to reconcile the content of this slide with the latest, reliable evidence

Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- COVID-19 Transmission
- **COVID-19 & Air Quality**
- Building Forward Better

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH
Heal and Transform Lives

There is available (and growing) evidence on airborne transmission of SARS-CoV-2 through aerosols

(updated as of October 23, 2020)

[High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice — Skagit County, Washington, March 2020]

"Following a 2.5-hour choir practice attended by 61 persons, including a symptomatic index patient, 32 confirmed and 20 probable secondary COVID-19 cases occurred (attack rate = 53.3% to 86.7%); three patients were hospitalized, and two died. Transmission was likely **facilitated by close proximity (within 6 feet) during practice and augmented by the act of singing"**

NOTE: The science on COVID-19 transmission is constantly evolving. Please continue to reconcile the content of this slide with the latest, reliable evidence

Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- COVID-19 Transmission
- **COVID-19 & Air Quality**
- Building Forward Better

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH
Heal and Transform Lives

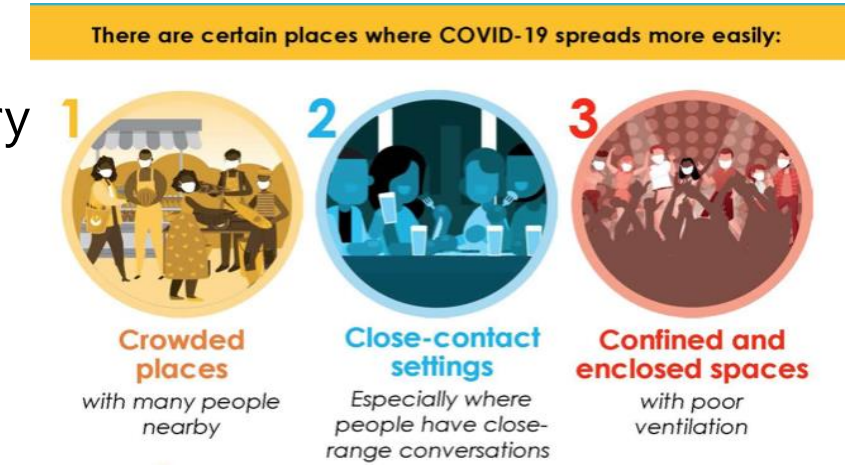
Airborne transmission of SARS-CoV-2 is more likely to happen under certain circumstances

- **Enclosed spaces** within which an infectious person either exposed susceptible people at the same time or to which susceptible people were exposed shortly after the infectious person had left the space.
- **Prolonged exposure to respiratory particles**, often generated with expiratory exertion (e.g., shouting, singing, exercising) that increased the concentration of suspended respiratory droplets in the air space.
- **Inadequate ventilation or air handling** that allowed a build-up of suspended small respiratory droplets and particles.

University of Nebraska Medical Center

3Vs of super-spreader events

- **Venue:** Multiple people indoors, where social distancing is often harder
- **Ventilation** -Staying in one place where air is not being exchanged, diluted, or filtered
- **Vocalization** - lots of people are talking or singing, which can aerosolize virus



NOTE: The science on COVID-19 transmission is constantly evolving. Please continue to reconcile the content of this slide with the latest, reliable evidence

Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- COVID-19 Transmission
- COVID-19 & Air Quality
- **Building Forward Better**

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH

Heal and Transform Lives

Current agreements on COVID-19 prevention in Indoor Spaces (CDC, WHO, DOH, IATF)

- **Existing interventions to prevent the spread of SARS-CoV-2 appear sufficient** to address transmission both through close contact and under the special circumstances favorable to potential airborne transmission.
- Accompanied by social distancing, use of masks in the community, hand hygiene, and surface cleaning and disinfection, **ventilation** and **avoidance of crowded indoor spaces** are especially relevant for indoor \ spaces, where circumstances can increase the concentration of suspended small droplets and particles carrying infectious virus.
- **At this time, there is no indication of a general community need to use special engineering controls**, such as those required to protect against airborne transmission of infections, like measles or tuberculosis, in the healthcare setting.

NOTE: No single measure, by itself, is enough to protect people from COVID-19. Any intervention or technology must be used along with bets practices recommended by DOH, IATF, and WHO

Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- COVID-19 Transmission
- COVID-19 & Air Quality
- **Building Forward Better**

Venue Considerations: Occupancy & Exposure Time

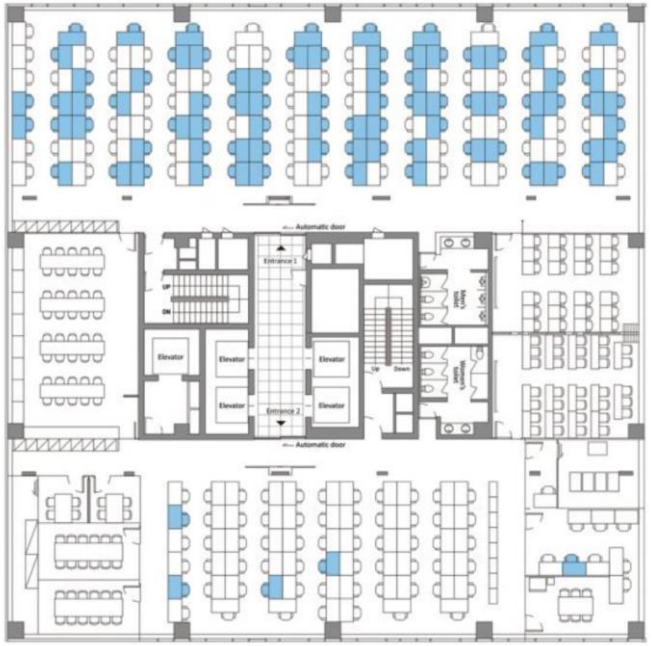
- The odds of catching COVID-19 indoors are **18.7 times higher than in open-air environments**

Frieden TR, Lee CT. Identifying and Interrupting Superspreading Events Implications for Control of Severe Acute Respiratory Syndrome Coronavirus 2. Emerging Infectious Diseases. 2020;26(6):1059-1066.

- CDC presently defines a COVID-19 “close contact” as any encounter in which an individual is within 6 feet of an infected person for at least 15 minutes
- Adherence to the Six-Foot Rule would limit large-drop transmission **but not sufficiently to airborne transmission in enclosed spaces.**

Martin Z. Bazant; John W. M. Bush Beyond Six Feet: A Guideline to Limit Indoor Airborne Transmission of COVID-19.

- In lieu of gross minimum health standards, guidelines for room occupancy and exposure time **may be better contextualized based on floor area, room volume, ventilation capacity, air recirculation and exchange rates, and expected activity.**



A Korean call center where COVID-19 spread rapidly. Blue seats indicate people who tested positive – some located on the far side of the building floor. Source: Centers for Disease Control and Prevention

NOTE: No single measure, by itself, is enough to protect people from COVID-19. Any intervention or technology must be used along with bets practices recommended by DOH, IATF, and WHO

Transmission and Prevention of COVID-19 in Indoor settings

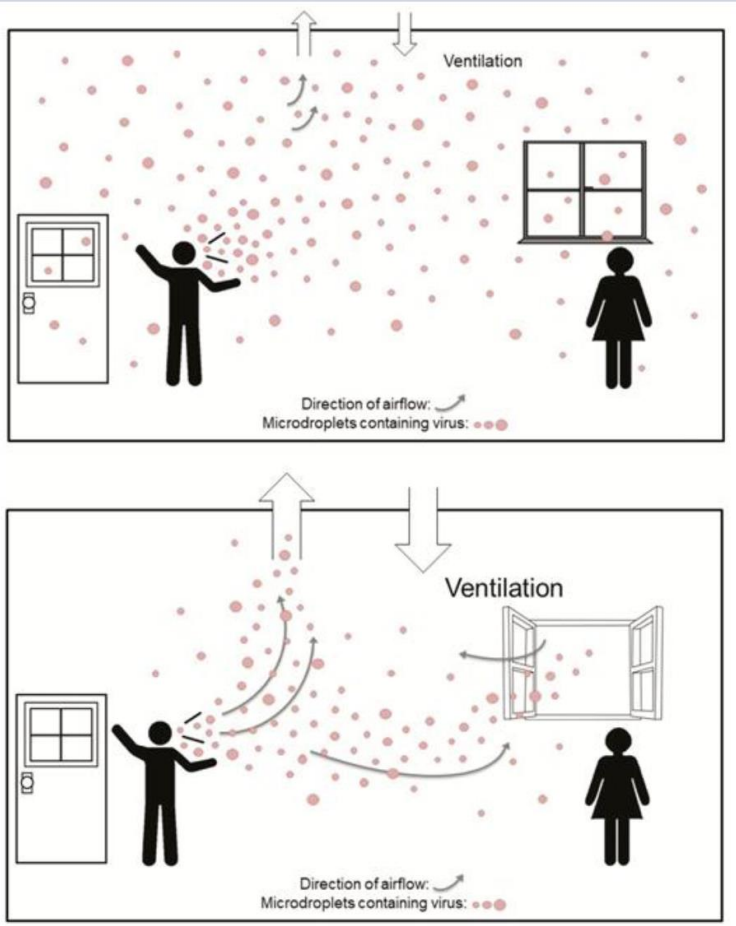
- Preliminaries
- COVID-19 Transmission
- COVID-19 & Air Quality
- **Building Forward Better**

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH

Heal and Transform Lives

Ventilation Considerations

- **CDC:** Lowering the indoor air concentration of SARS CoV-2 by means of ventilation and filtration **can play a role in controlling transmission of COVID-19**, in addition to social distancing, cleaning and disinfection.
- Ventilation is also a critical measure that can be taken to reduce exposure to cleaning products, disinfectants, and the byproducts they produce as a result of chemical reactions in indoor air.
- **General Strategies:**
  - Use natural ventilation instead of mechanical ventilation whenever possible. (WHO, CDC)
    - Caveat: except in high outdoor pollution
  - Minimize recirculating air (CDC)
  - Increased ventilation in high occupancy and high-traffic areas. (WHO, CDC)
  - Avoid mixing air between high-risk roomS (CDC)
  - Supplement general ventilation with airborne infection controls such as local exhaust, high efficiency air filtration, and germicidal ultraviolet lights. (CDC)



Distribution of respiratory microdroplets in an indoor environment with (*A*) inadequate ventilation and (*B*) adequate ventilation.

Source: L Morawska, D Milton. It Is Time to Address Airborne Transmission of Coronavirus Disease 2019 (COVID-19). Clinical Infectious Diseases, ciaa939

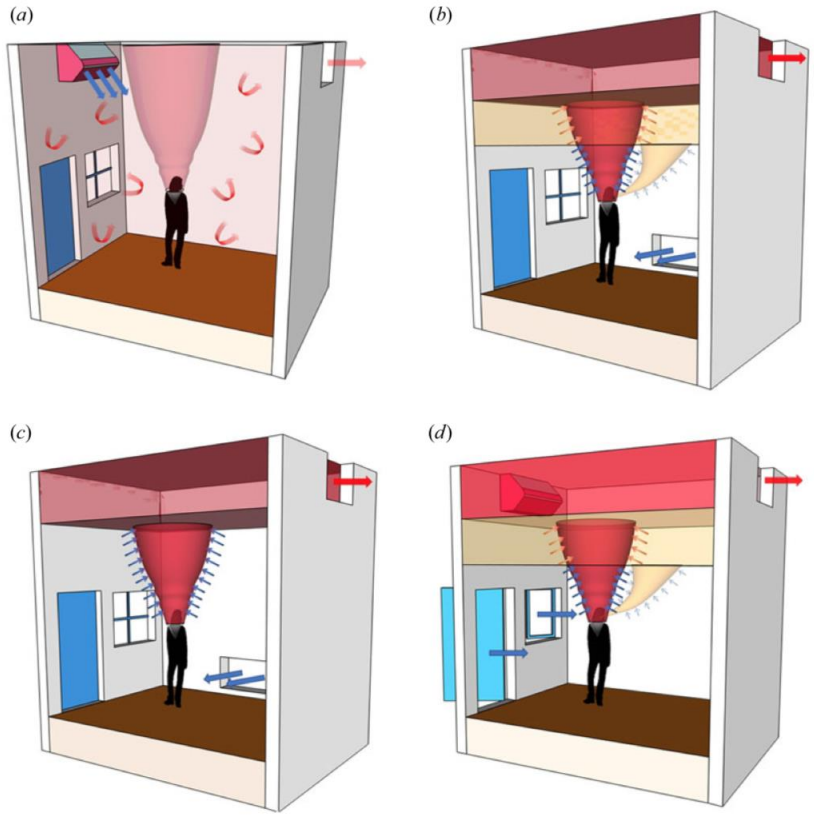
NOTE: No single measure, by itself, is enough to protect people from COVID-19. Any intervention or technology must be used along with bets practices recommended by DOH, IATF, and WHO

Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- COVID-19 Transmission
- COVID-19 & Air Quality
- **Building Forward Better**

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH
Heal and Transform Lives

Ventilation Considerations



Displacement ventilation, which encourages vertical stratification, seems to be the most effective at reducing the exposure risk. Mixing ventilation distributes the air throughout the space and does not provide any potentially clean zones.

Bhagat, R., Davies Wykes, M., Dalziel, S., & Linden, P. (2020). Effects of ventilation on the indoor spread of COVID-19. *Journal of Fluid Mechanics, 903*, F1. doi:10.1017/jfm.2020.720

ASHRAE American Society of Heating, Refrigerating and Air-conditioning Engineers

Well maintained and operated ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air.

Unconditioned spaces can cause thermal stress to people that may be directly life threatening and that may also lower resistance to infection.

In general, disabling of heating, ventilating, and air-conditioning systems is not a recommended measure to reduce the transmission of the virus.

NOTE: No single measure, by itself, is enough to protect people from COVID-19. Any intervention or technology must be used along with bets practices recommended by DOH, IATF, and WHO

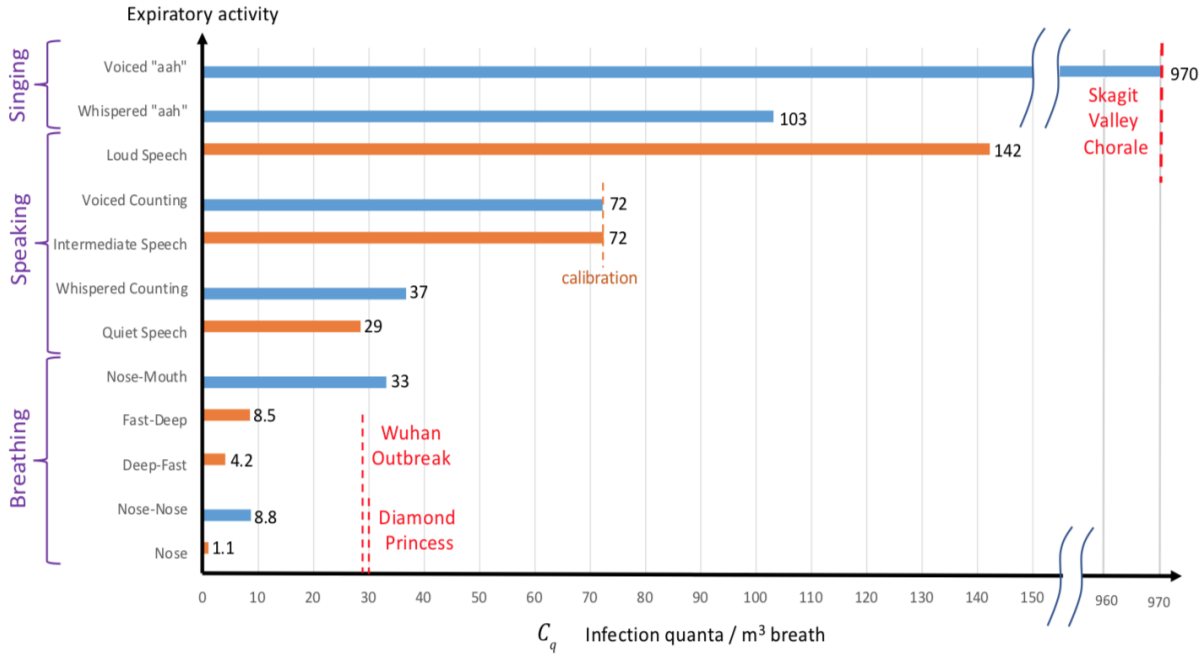
Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- COVID-19 Transmission
- COVID-19 & Air Quality
- **Building Forward Better**

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH

Heal and Transform Lives

Implications on Vocal Activities



Estimates of the COVID-19 "infectiousness" of exhaled air, Cq, defined as the concentration of infection quanta in the breath of an infected person, for various respiratory activities.

Morawska, L. *et al.* Size distribution and sites of origin of droplets expelled from the human respiratory tract during expiratory activities. *Journal of Aerosol Science* 40, 256–269 (2009).

- Ensure compliance with **universal masking**
- **Limit vocal activities** and **introduce barriers** as necessary

World Health Organization

"Reusable cloth masks afford the same efficacy as surgical masks for general public use. Medical grade masks should be reserved for HCWs and high-risk populations"

NOTE: No single measure, by itself, is enough to protect people from COVID-19. Any intervention or technology must be used along with bets practices recommended by DOH, IATF, and WHO

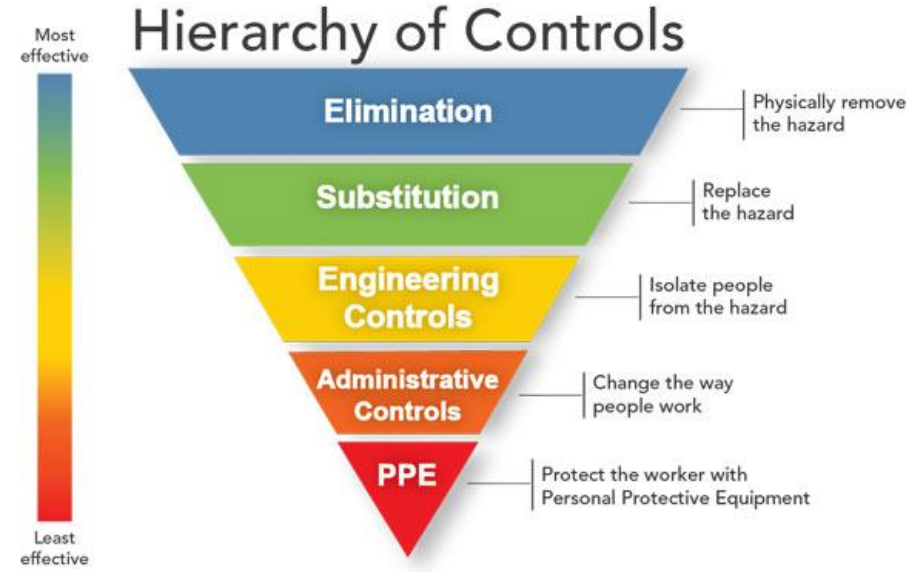
Transmission and Prevention of COVID-19 in Indoor settings

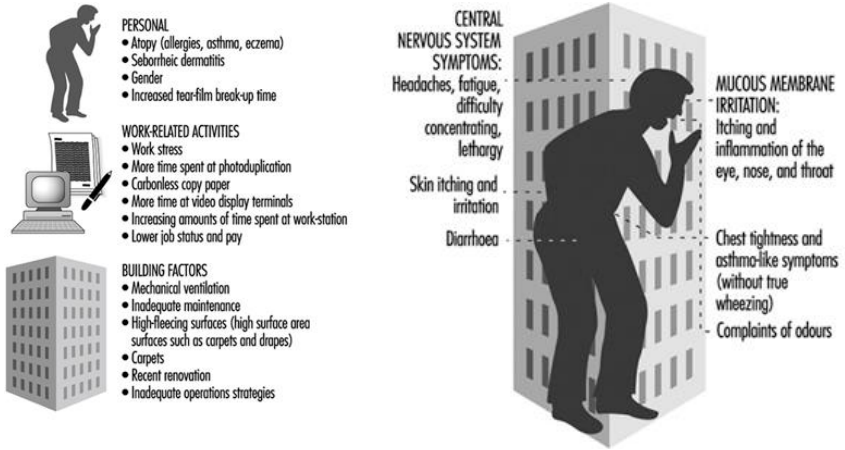
- ► Preliminaries
- ► COVID-19 Transmission
- ► COVID-19 & Air Quality
- ► **Building Forward Better**

ATENEO | ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH
Heal and Transform Lives

Concluding Remarks (More Caveats!)

- **Neither "indoors" nor "outdoors" is universally safe.**
- Understanding the complexity and how multi-factorial COVID-19 transmission is should encourage pursuit of an **optimal mix of interventions**
- Do not lose sight of **other compounding and synchronous hazards and risk**s (Sick building syndrome, Indoor air pollution)
- Learning from each other through **"Communities of practice"**





NOTE: No single measure, by itself, is enough to protect people from COVID-19. Any intervention or technology must be used along with bets practices recommended by DOH, IATF, and WHO

Managing and Monitoring Air Quality in Ortigas

Transmission and Prevention of COVID-19 in Indoor settings

- Preliminaries
- COVID-19 Transmission
- COVID-19 & Air Quality
- Building Forward Better

ATENEO SCHOOL OF MEDICINE AND PUBLIC HEALTH

Heal and Transform Lives

Beyond Six Feet:

Transmission and Prevention of COVID-19 in Indoor Settings

GEMINN LOUIS C. APOSTOL, MD, MBA

Head Environmental Health Specialist, Ateneo School of Medicine and Public health
Scientific Expert, Philippine Inter-agency Committee on Environmental Health (IACEH)
Private Sector Specialist, ThinkWell LLC