Covid-19 risk linked to poor ventilation system

Creating awareness to prevent air-borne infection

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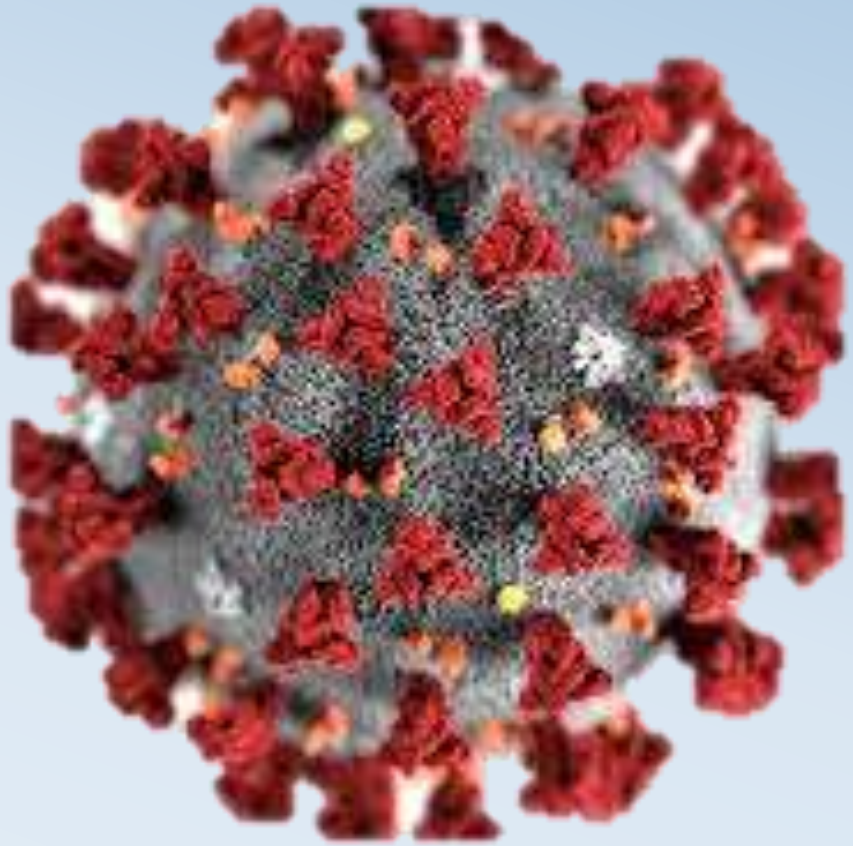
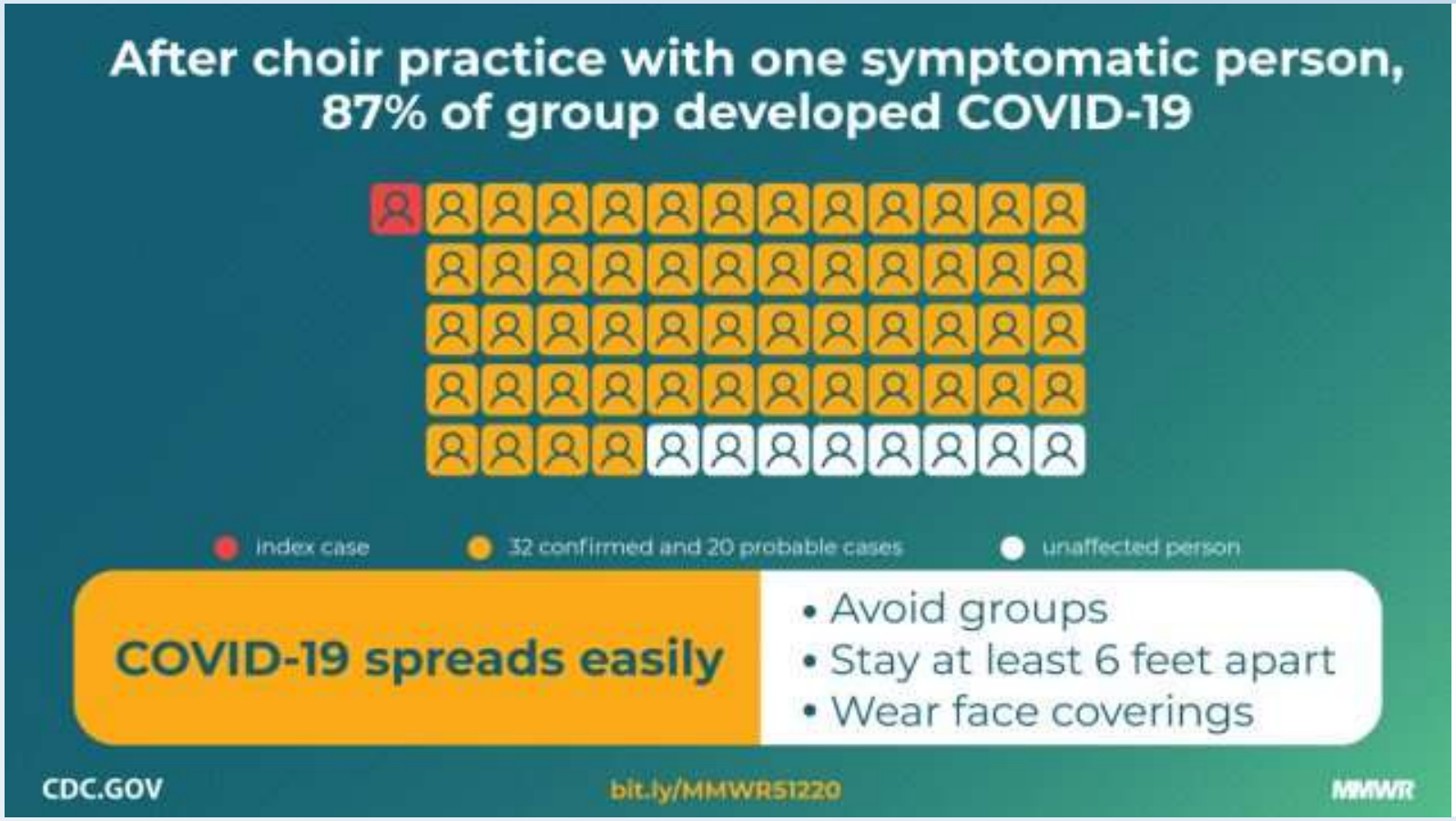


Infection case 1



Summary

What is already known about this topic?

Superspreading events involving SARS-CoV-2, the virus that causes COVID-19, have been reported.

What is added by this report?

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.

What are the implications for public health practice?

The potential for superspreader events underscores the importance of physical distancing, including avoiding gathering in large groups, to control spread of COVID-19. Enhancing community awareness can encourage symptomatic persons and contacts of ill persons to isolate or self-quarantine to prevent ongoing transmission.

Infection case 2

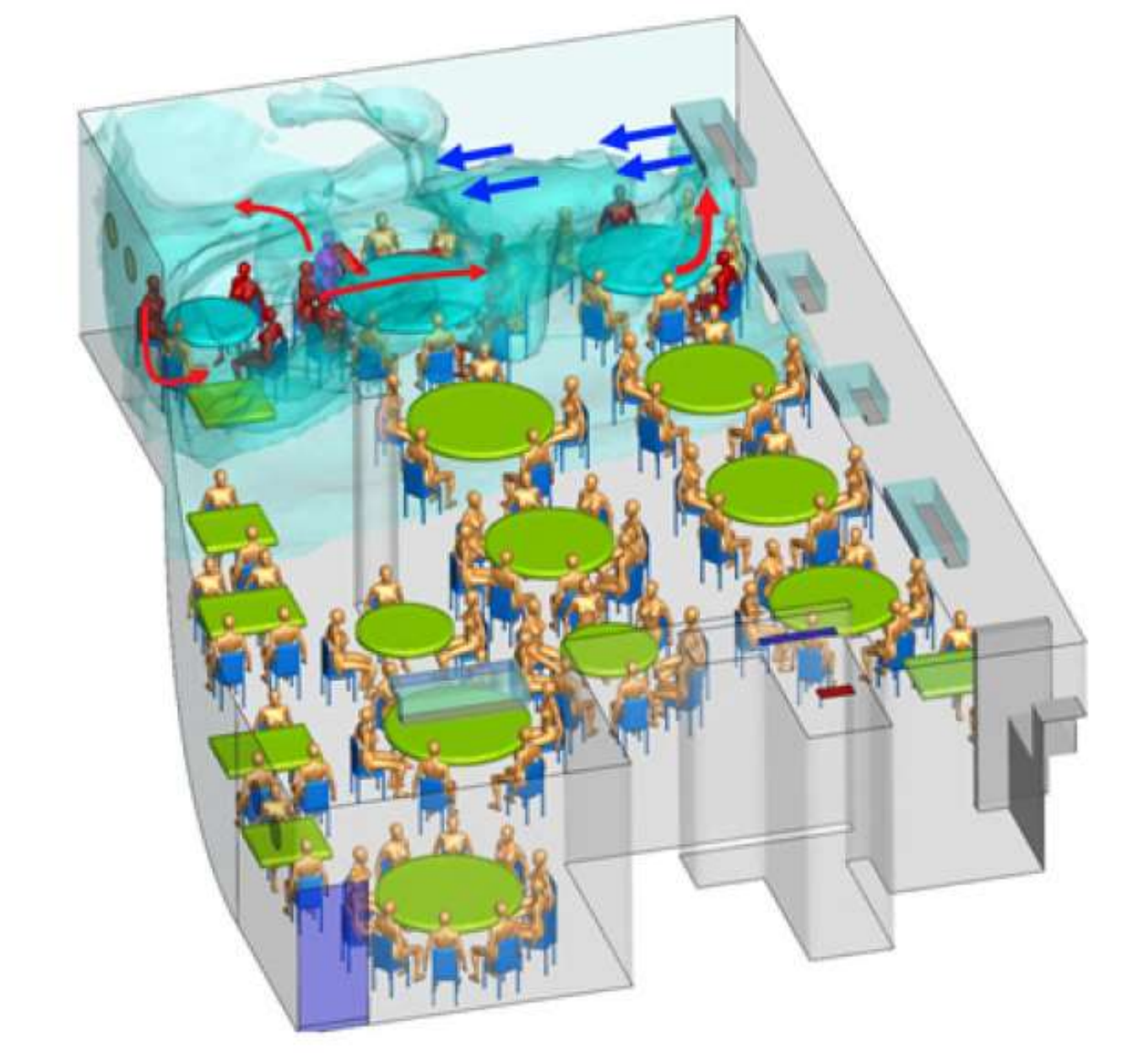
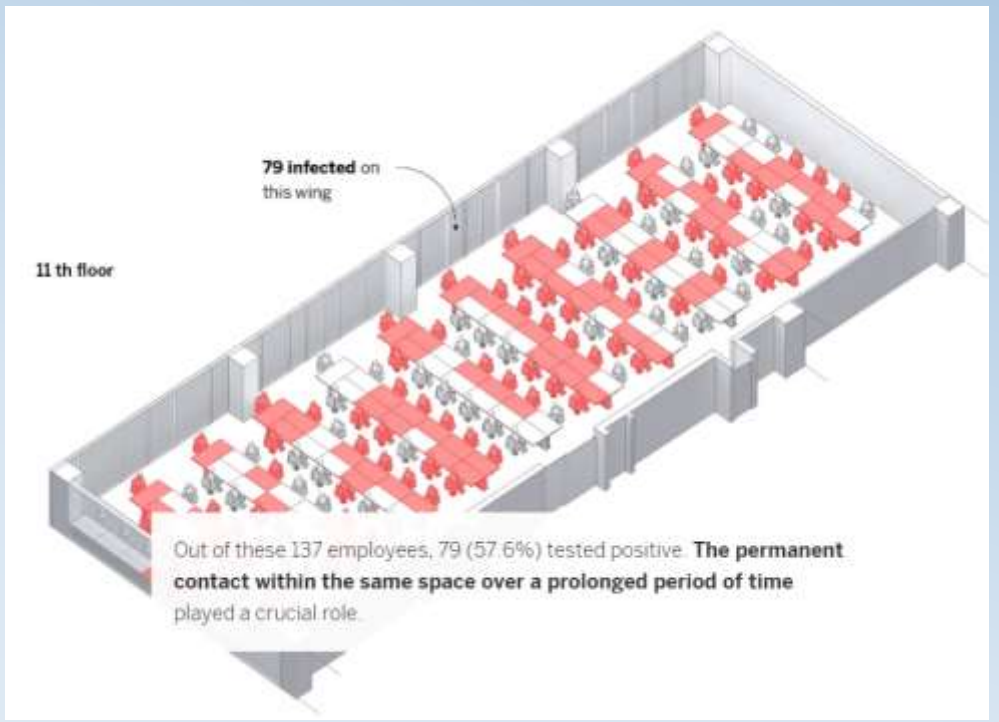
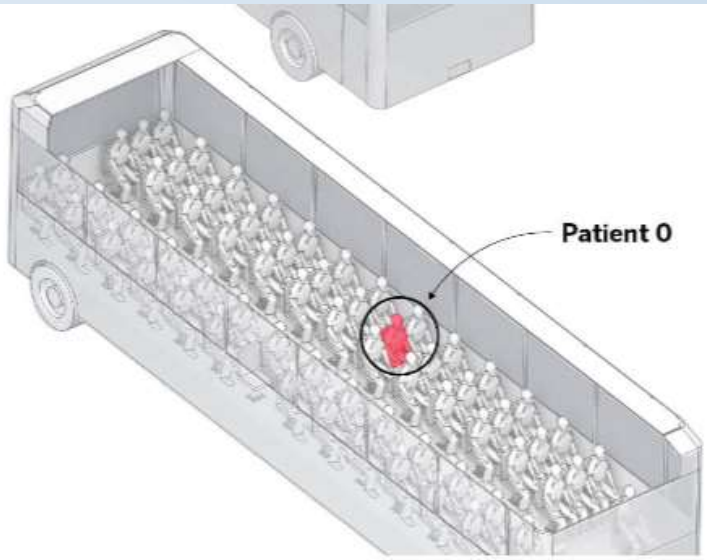


FIGURE 5 Schematic showing arrangement of restaurant tables and air conditioning airflow at site of a COVID-19 outbreak in Guangzhou, China, 2020. NOTE: Red indicates seating of future case patients; blue indicates the index case patient.

Infection case 3

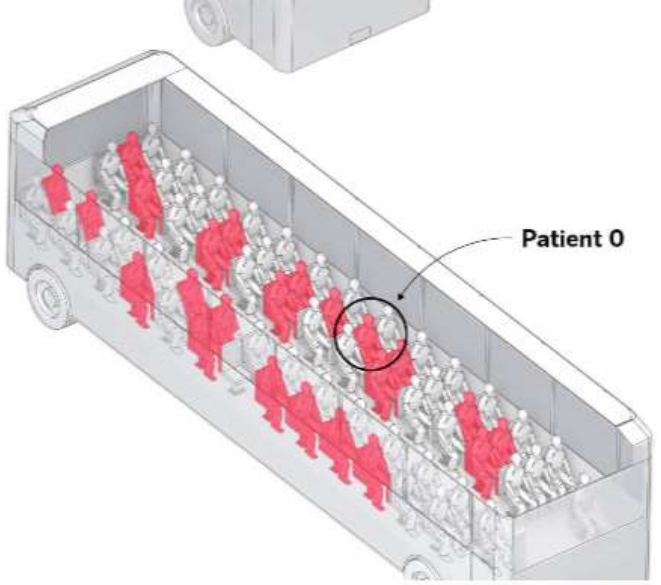


Infection case 4



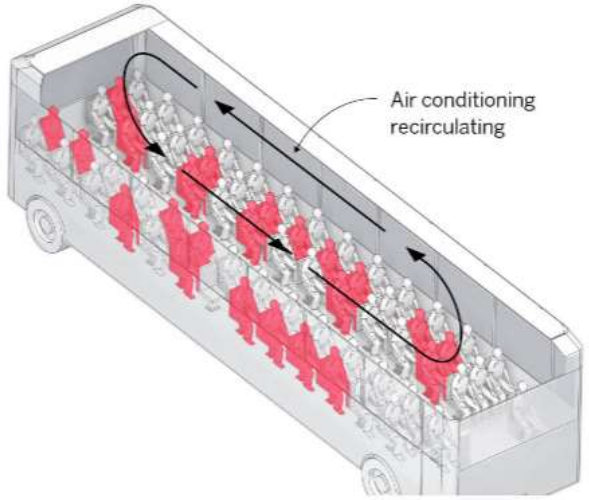
Patient 0, a 64-year-old woman, had been in contact with people from Wuhan. She had no symptoms until the following day.

23 infected from Covid-19 on the bus



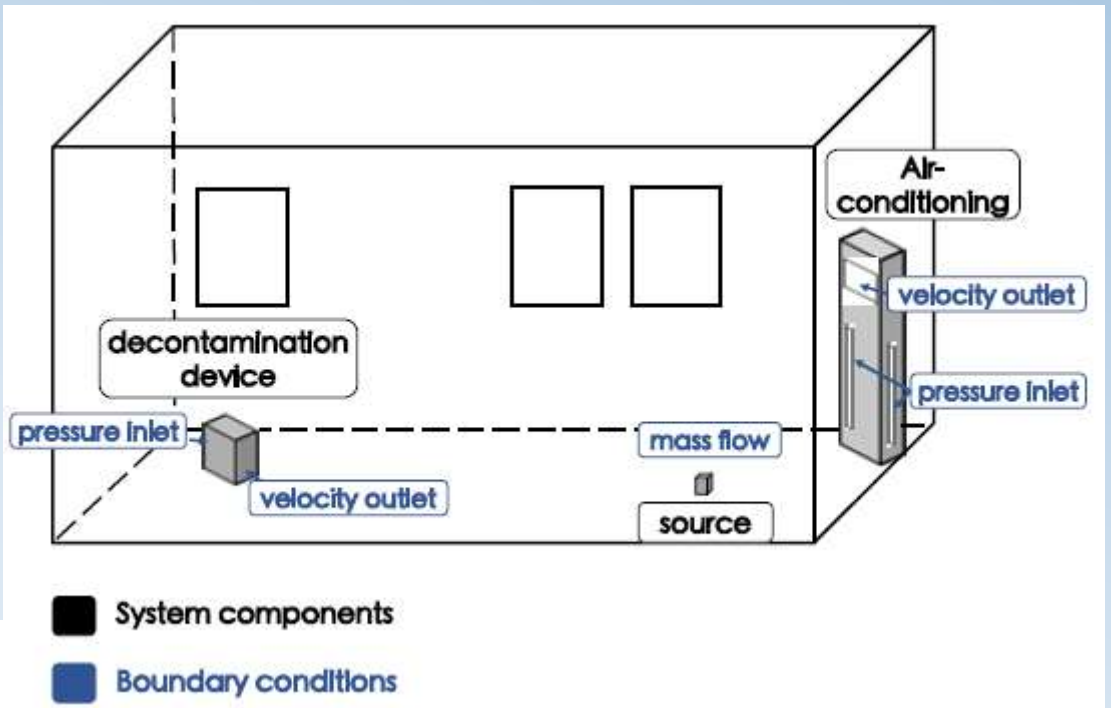
In total, **23 people got infected** on the bus. No one became ill on the other bus, despite the fact they were all mixing at the ceremony.

23 infected from Covid 19 on the bus



The air conditioning was on recirculation mode. The researchers believe that this was key; the passengers became infected regardless of their distance from Patient 0.

CFD analysis of gas flow in indoor space



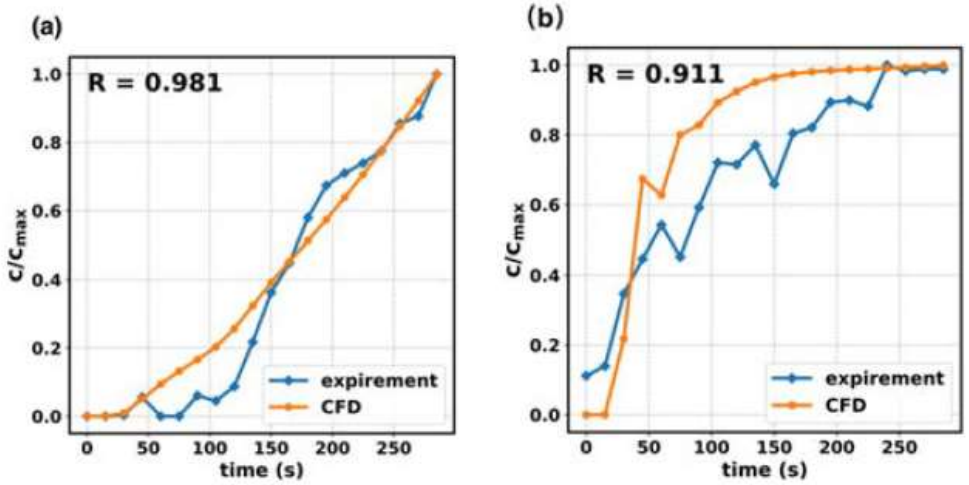


Figure 2. Comparisons of concentration ratio in different modes in experiments and CFD simulations. (a) natural diffusion mode; (b) air-conditioned mode.

Jiawen Xv 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **453** 012020

CFD analysis-natural diffusion

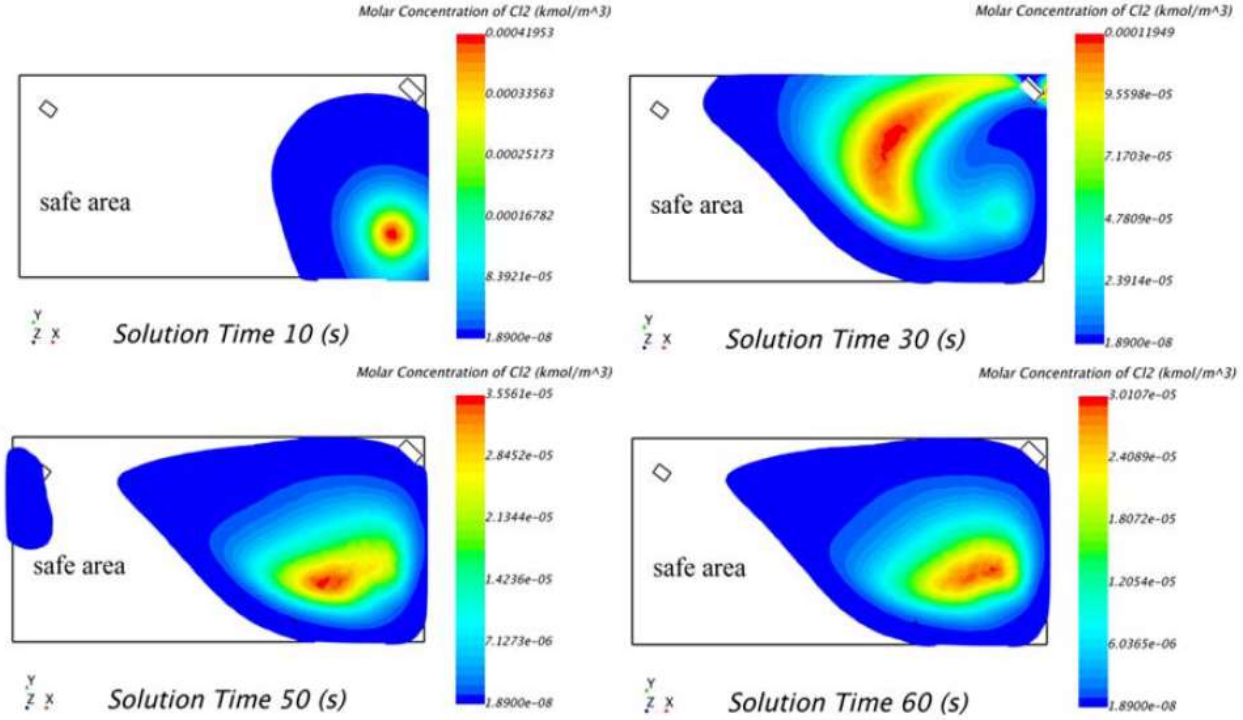


Figure 4. Concentration distribution evolution of toxic gas in the natural diffusion mode.

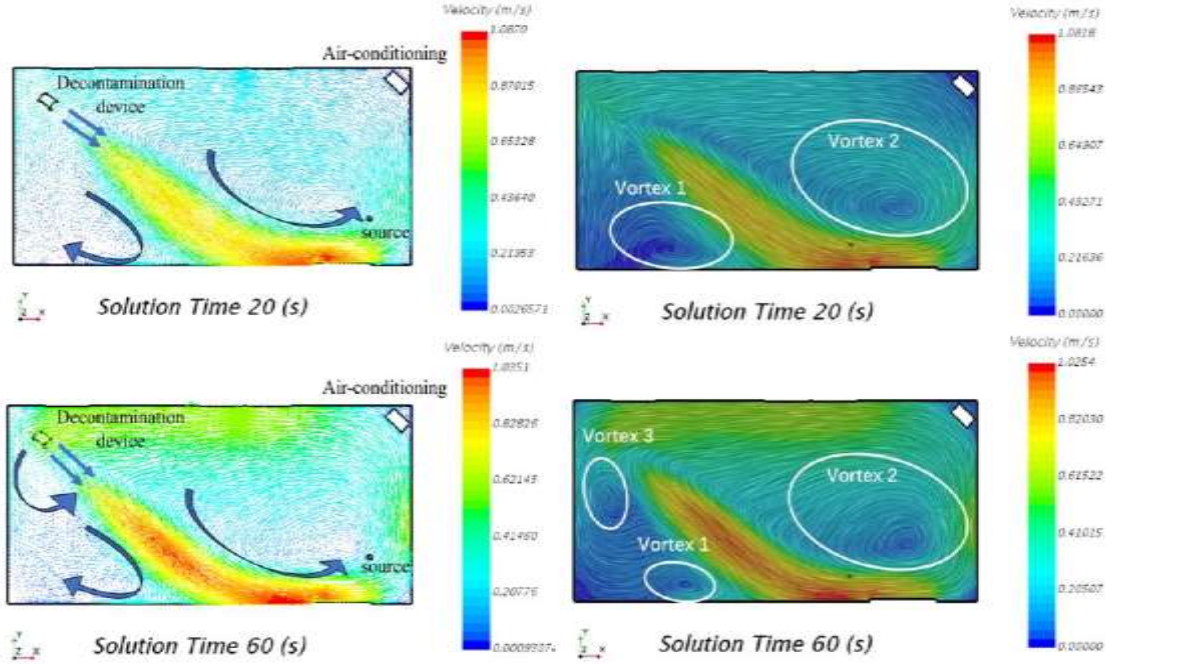


Figure 3. Velocity field distribution at T=20 s and T=60 s in the natural diffusion environment. The left column is graphic display mode and the right column is line integral convolution display mode.

CFD analysis-air condition mode

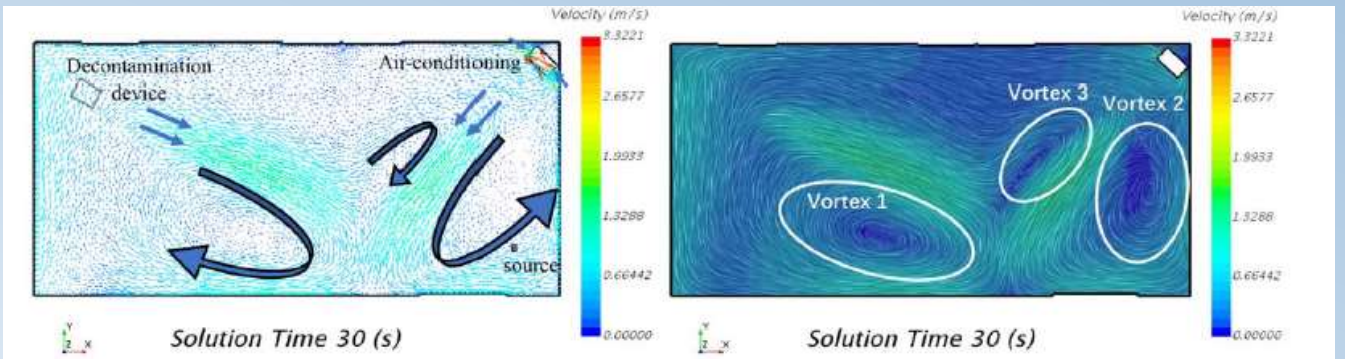


Figure 5. Velocity field distribution at T=30s in air-conditioned mode. The left is graphic display mode and the right is line integral convolution display mode.

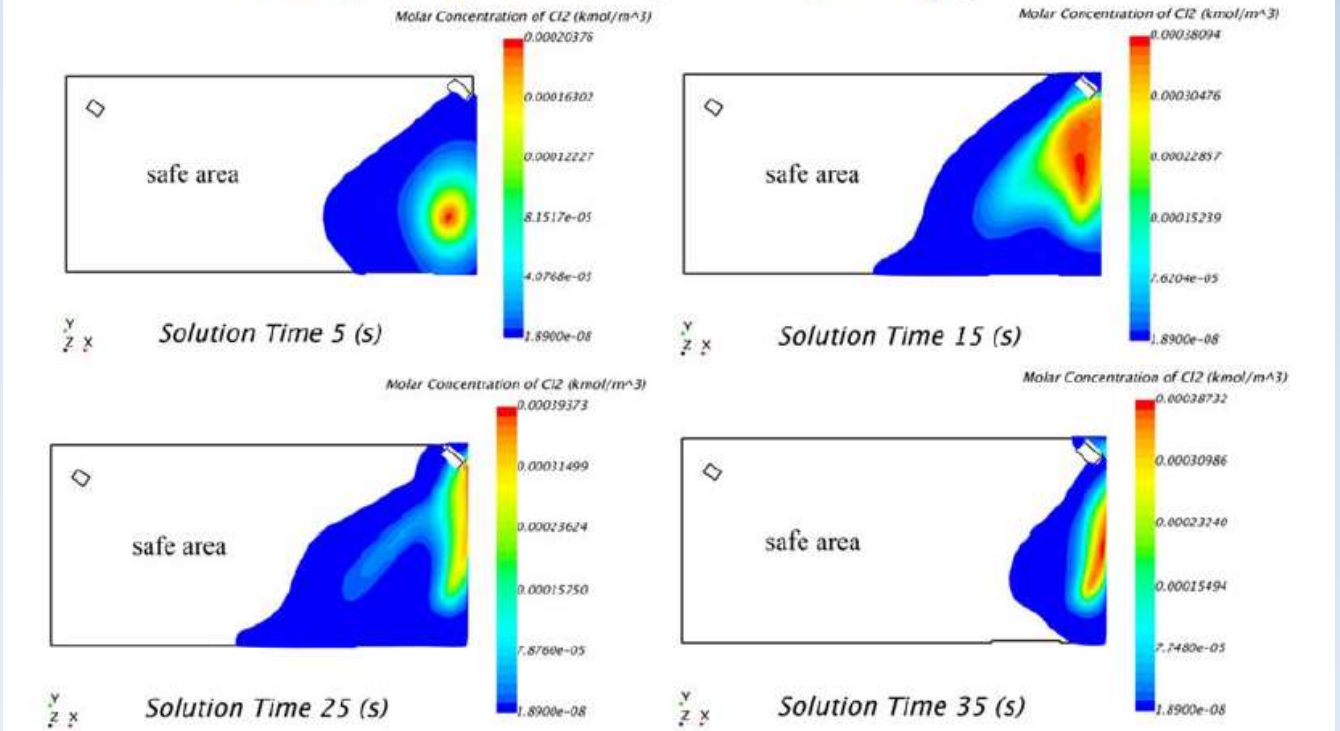
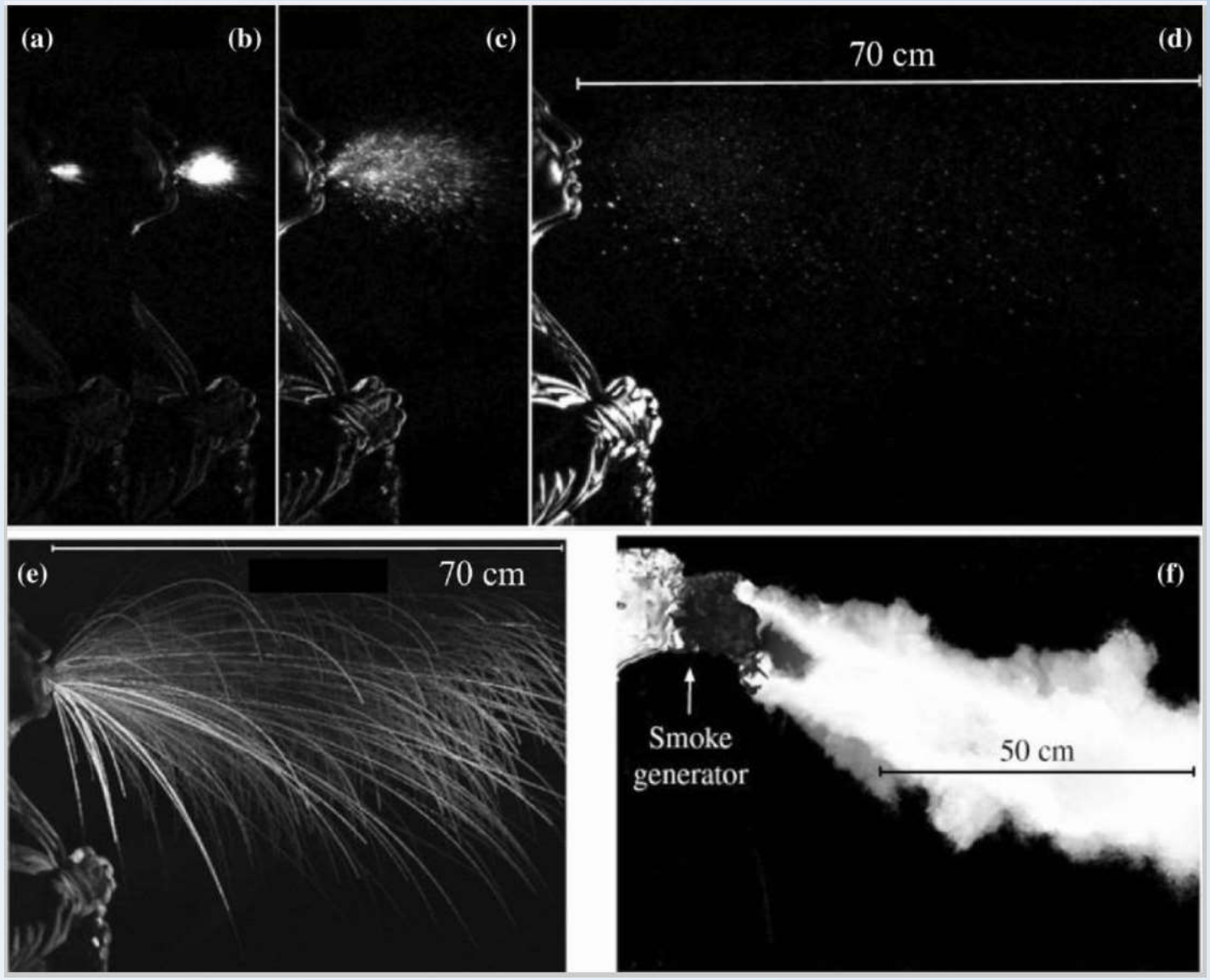


Figure 6. Concentration distribution evolution of toxic gas in air-conditioned mode.

Aerosol experimental study-cough

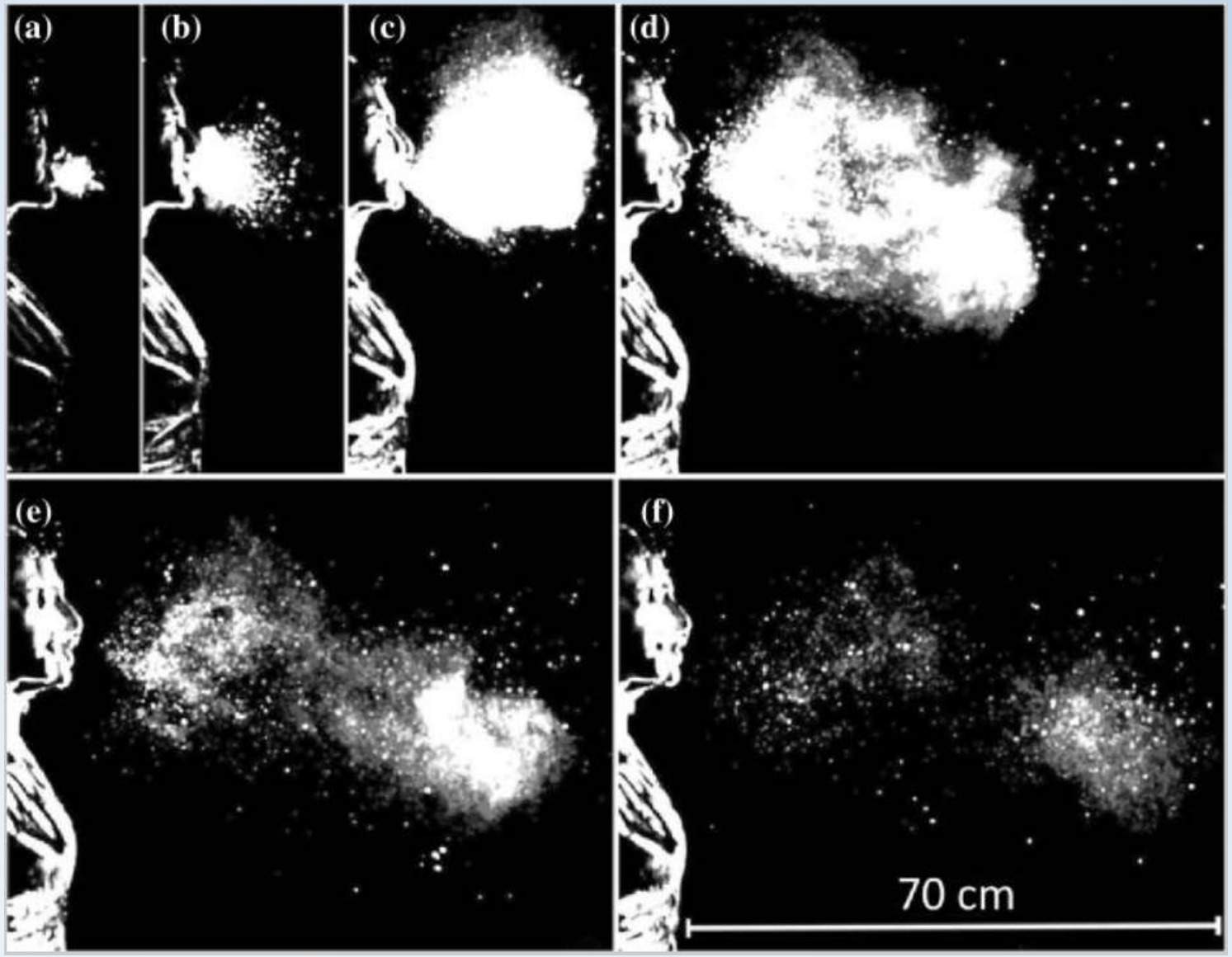


Images of the cloud released by a cough event recorded at a frequency of 1000 fps.
(a) 0.006 s, (b) 0.01 s, (c) 0.029 s and (d) 0.106 s.
(e) Ballistic trajectories of the largest droplets
(f) Smoke visualization of the motion of the gas phase recorded at 2000 fps.

In (e) the instantaneous images of the trajectories of all the droplets recorded throughout the entire sequence are superimposed.

Bourouiba L, Dehandschoewercker E, Bush JMW (2014) Violent expiratory events: on coughing and sneezing. J Fluid Mech 745:537–563.

Aerosol experimental study-sneezing



Images of the cloud expelled by sneezing, recorded at a frequency of 1000 fps (a) 0.007 s, (b) 0.03 s, (c) 0.1 07 s, (d) 0.162 s, (e) 0.251 s, (f) 0.34 s

Air-borne Transmission of Sars-Cov-2

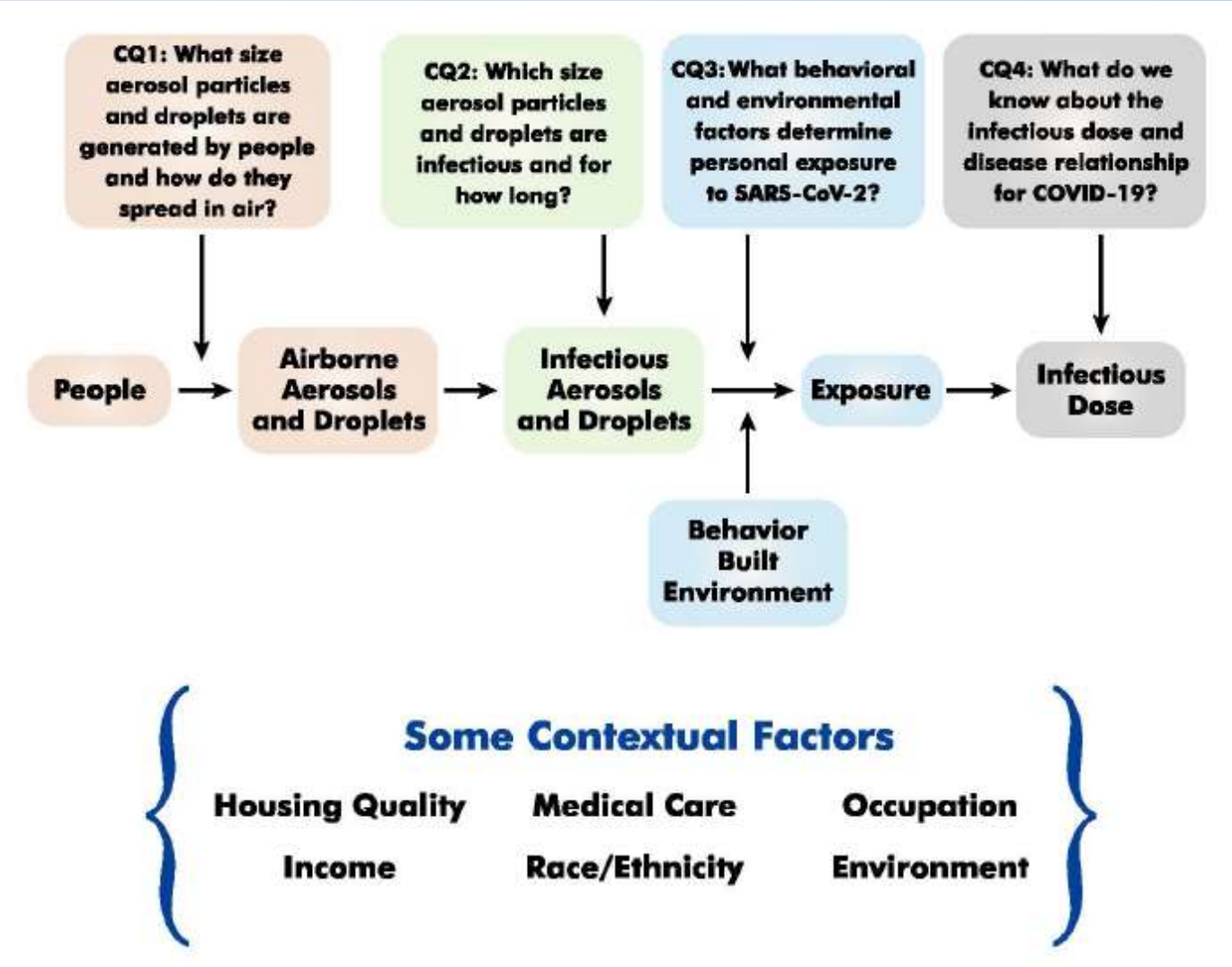
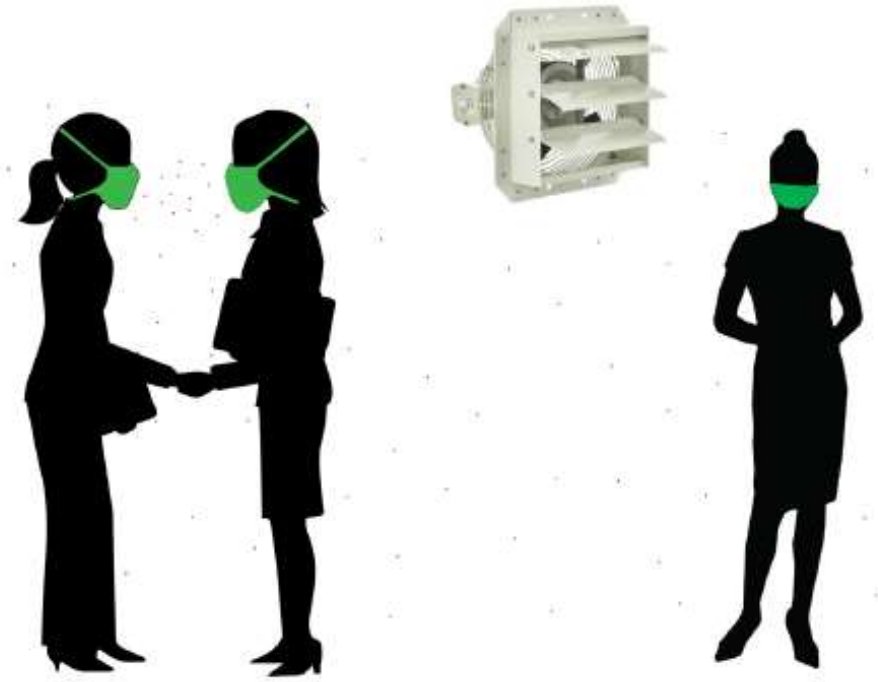


Figure 1: Framework for Airborne Transmission of Sars-CoV-2

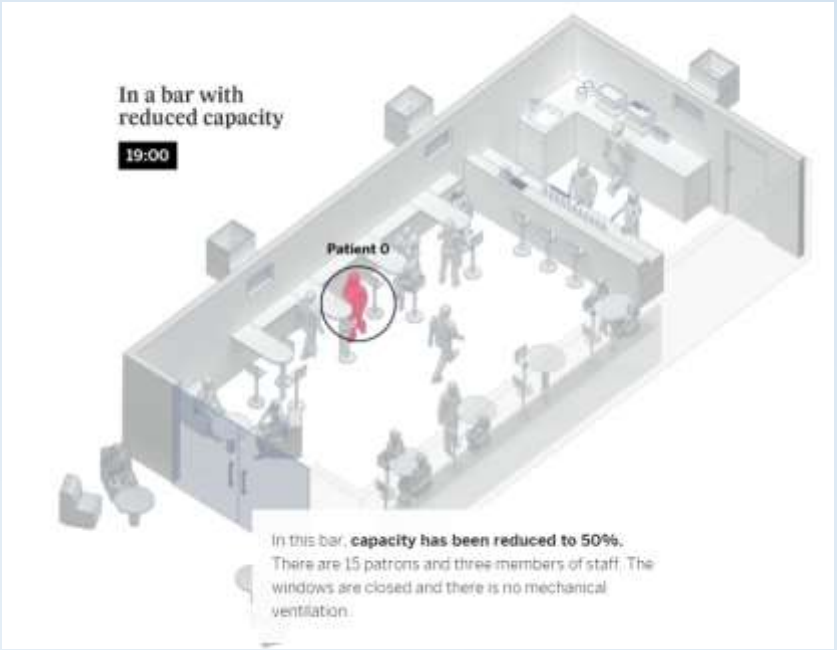
AIRBORNE TRANSMISSION OF SARS-CoV-2 Proceedings of a Workshop, National Academy of Sciences, Oct 2020

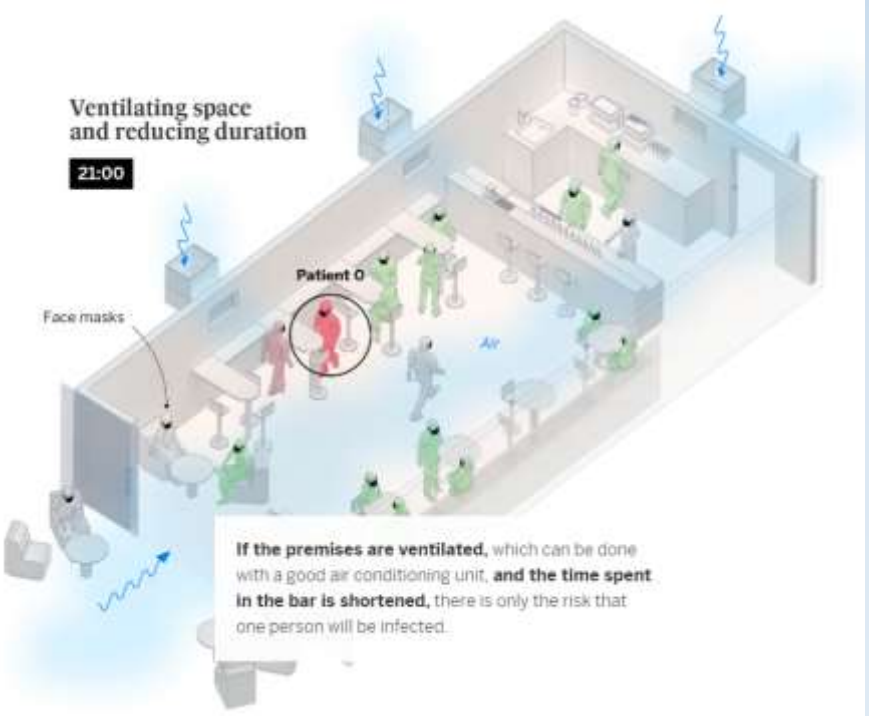


- **Source control:** Source control can greatly reduce, if not completely eliminate, the number of aerosols released into the air
- **Ventilation/filtration:** With effective ventilation/filtration, the number of viral aerosols can be greatly reduced
- **Distance and personal protective equipment:** These interventions can offer some protection by reducing a person's exposure
- **Hygiene:** Research indicates that the highest viral loads or positive samples can be found on the floor. Cleaning the floor can reduce the possibility of resuspension

FIGURE 2 Interventions to reduce the spread of SARS-CoV-2. Four basic categories of interventions, described by Marr (2020), can result in a significant reduction in the risk of airborne transmission of SARS-CoV-2.

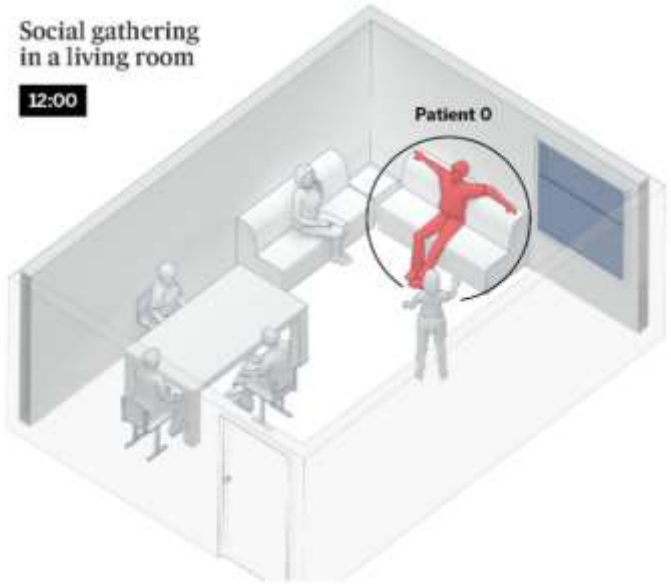
Scenario A: Bar



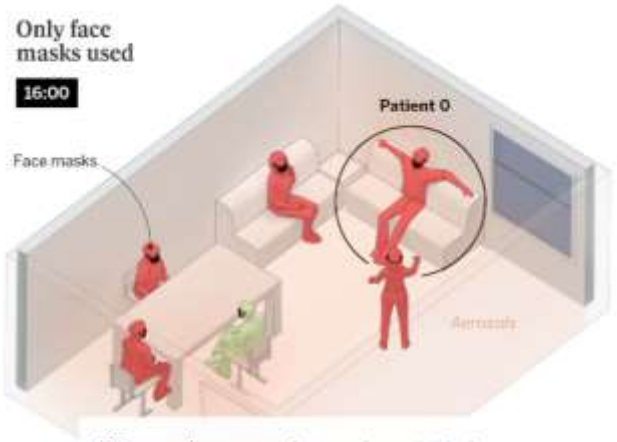


https://english.elpais.com/society/2020-10-28/a-room-a-bar-and-a-class-how-the-coronavirus-is-spread-through-the-air.html

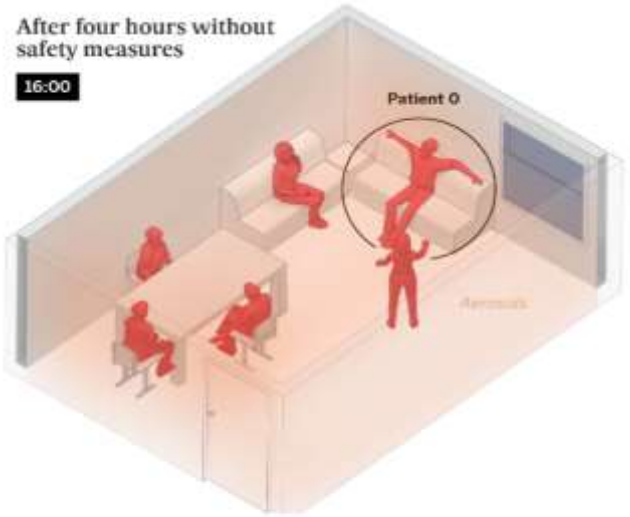
Scenario B: Room



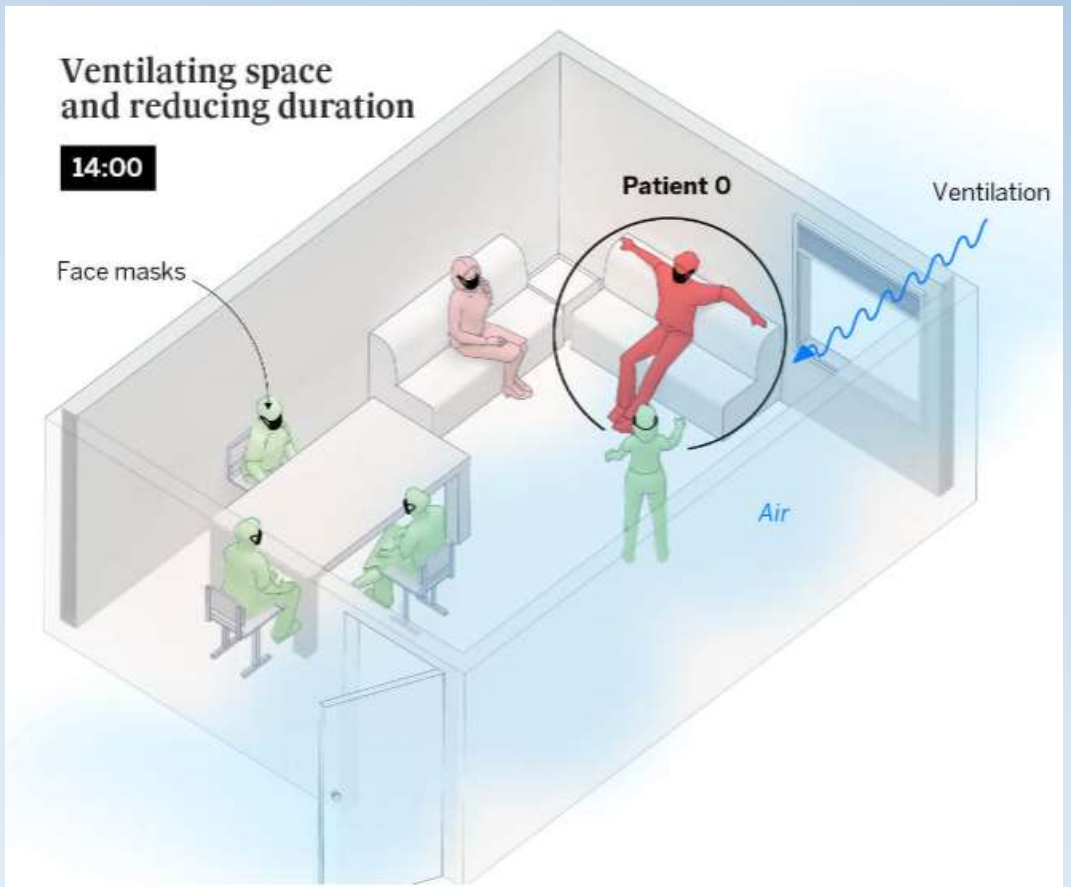
Six people get together in a private home, one of whom is infected. **Some 31% of coronavirus outbreaks recorded in Spain** are caused by this kind of gathering, mainly between family and friends.



If face masks are worn, four people are at risk of infection. Masks alone will not prevent infection if the exposure is prolonged.

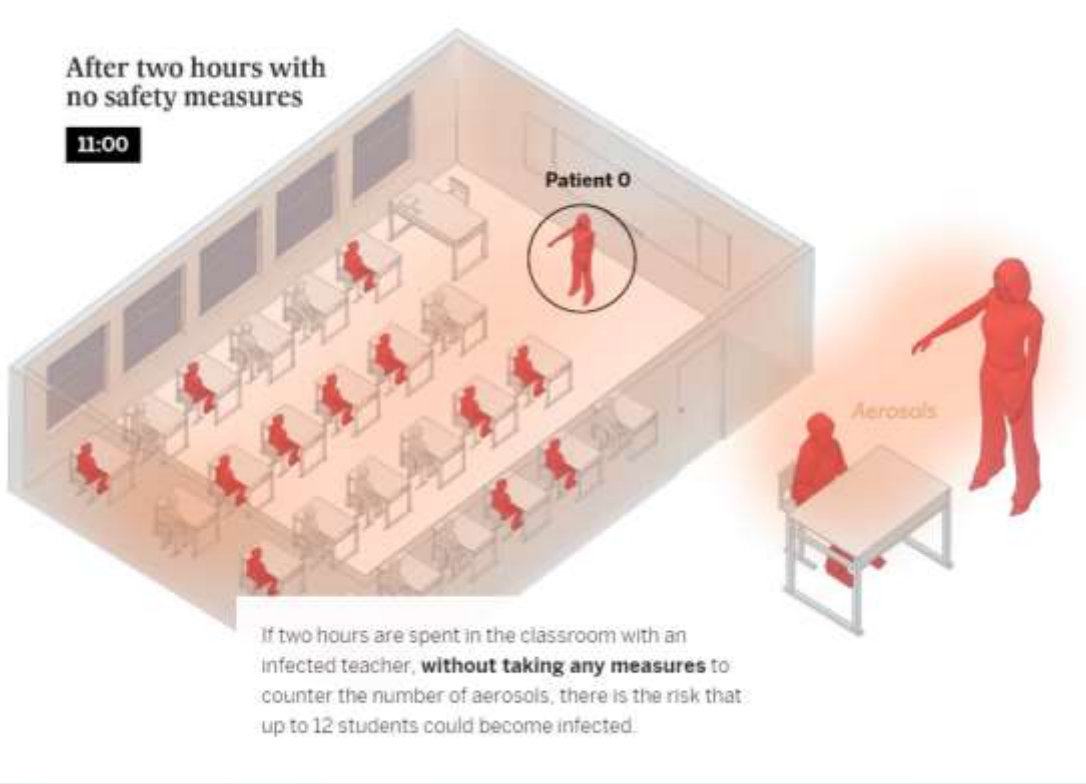


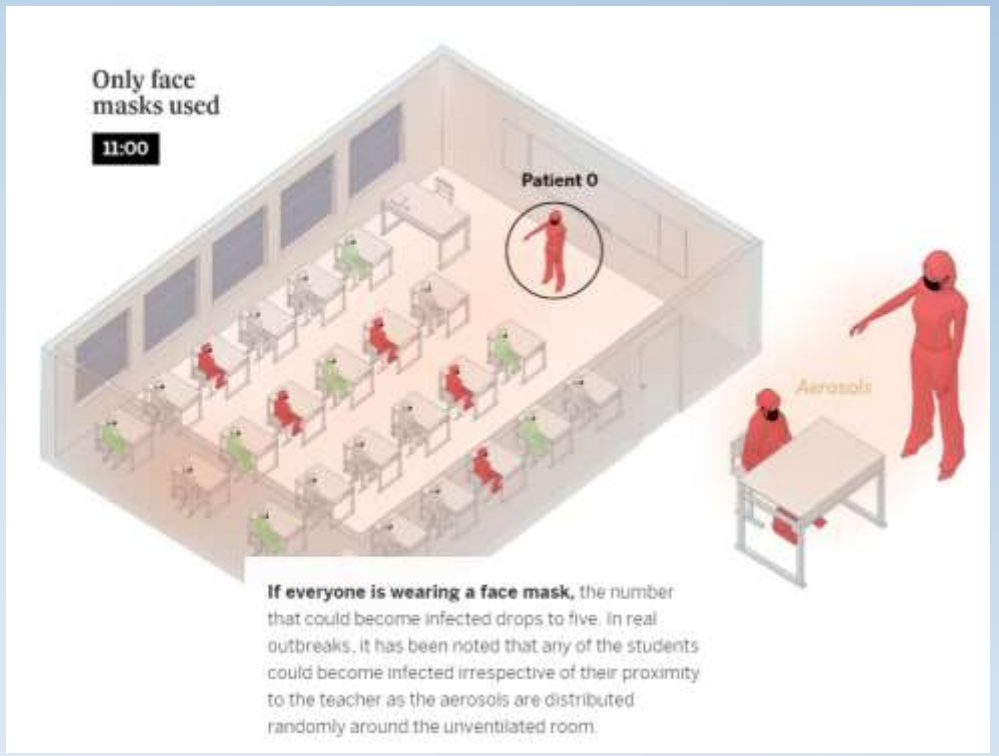
Irrespective of whether safe distances are maintained, if the six people spend four hours together talking loudly, without wearing a face mask in a room with no ventilation, **five will become infected,** according to the scientific model explained in the methodology.

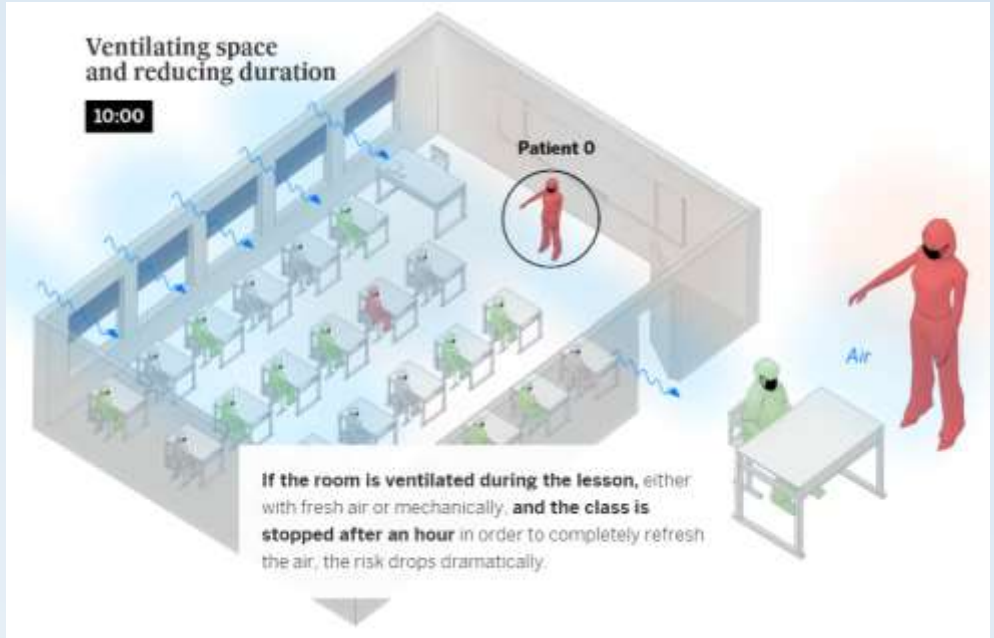


The risk of infection drops to below one when the group **uses face masks, shortens the length of the gathering by half and ventilates the space used.**

Scenario C: Classroom







Thank you for listening