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The evidence for preventing covid-19 is lost in translation

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Why don't we just open the windows?

The evidence for preventing covid-19 is lost in translation

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The world is finally coming to terms with the realisation that transmission of SARS-CoV-2 is airborne.¹ First came the modelling studies, sizing up airborne particles, their trajectories, and viral load; and then came examples from the real world, completing the gaps in the models and confirming that the pandemic virus is chiefly spread through tiny aerosolised respiratory particles.²⁻⁵ Trying to validate this by detecting live virus, however, is fraught with technical difficulties.⁶ Hence, the frenetic attempts at measuring the quantity of infectious virus in breath as well as revisiting knowledge on ventilation sciences.^{7,8} While keeping your distance, wearing a mask, and getting vaccinated have provided much protection, one intervention that would have a significant impact is adequate indoor ventilation. Healthcare, homes, schools, and workplaces should have been encouraged to improve ventilation at the very beginning of the pandemic, but tardy recognition of the airborne route by leading authorities in 2020 stalled any progress that could have been made at that stage.⁹⁻¹¹ This was compounded by controversies over the terms “droplet” and “aerosol,” as the definition of these dictates different infection prevention strategies, including type of mask.⁶

Inserting the term “ventilation” into a covid-19 policy document might appease readers, but ensuring people get enough fresh air in indoor environments seems to have fallen by the wayside.¹² Why is this? Can we establish the reasons for this seemingly lethargic response to improving indoor air quality?⁹

In order to answer, it is imperative to understand three fundamental principles of infection prevention and control.¹³ Firstly, most pathogens are invisible; secondly, you know the system has failed only when there is an outbreak; and, finally, you cannot always identify a specific cause, making it difficult to implement the most appropriate intervention. Infection control relies on a bundle of measures that are assumed to cover most transmission routes, explaining initial misguided emphasis on droplets and surface risk rather than unconstrained aerosol.¹¹

Common sense dictates so much of what is done for infection control, since most funding bodies consistently prioritise the most immediate, urgent, or commercially beneficial societal problems. Furthermore, current guidelines tend to focus on solid bodies, such as people; surfaces, both hard and soft; equipment; and water. Air is literally nebulous. Just as cleaning was the Cinderella of infection control during the past decade or so (and methicillin resistant *Staphylococcus aureus* sorted that out), we must now confront the neglected, but substantive, role of air in transmitting infection.¹⁴ It is fair to say that air could

be the final medium to define and standardise within the infection control itinerary.¹⁵

Another major compelling reason that air quality has been side lined is cost. Most buildings are neither designed nor well operated from the air quality aspect, with energy conservation and thermal comfort at the top of the list of requirements.^{16,17} Pumping in adequate amounts of fresh outside air, however engineered, will challenge running costs as well as carbon status.¹⁸ Outdoor air generally differs from indoor air in terms of temperature and humidity, and conditioning outdoor air needs significant energy. While evolving green technologies might be able to offset some of these increased energy requirements, any revision or upgrade of existing systems is a big undertaking and enormously expensive. Additionally, ventilation is usually controlled by building operators and owners, not necessarily individuals, and the former are not yet mandated by law to improve ventilation in public venues.¹⁸

Ventilation and air cleaning systems are noisy, drafty, and require fine tuning and regular maintenance.¹⁹ Even simple window opening invites discussion over chill, airflow, and security. There are some standards for indoor air quality, notably through proffered air changes, but these chiefly concern specialist healthcare environments such as operating theatres.²⁰ Indeed, existing ventilation standards hardly consider the risk of airborne infection in non-specialist public spaces at all.

So where are we now with indoor air quality? Clearly, better ventilation requires planning and investment, but who is going to ensure this and how should it be done? Upgrading internal air quality for billions of indoor environments in the world needs solid research, funding, and mandated standards. Those that we have are variable or are applied inconsistently. We have established public health strategies for foods and water and even pollution, but air quality inside most public venues in our communities resembles nothing more than miasmic uncertainty.^{14,15}

As with all major shifts in scientific understanding, tackling the final medium requires courage, investment, and political support for scientists and policy makers.²¹ The same applies to business and industry, who are already producing a range of air cleaning technologies and equipment. We cannot ignore airborne transmission any longer, however difficult or costly it may be to control.²² It is time to accept the fact that most people acquire SARS-CoV-2 by breathing in contaminated air. Window opening is a start, but it is not a panacea for covid-19 or, for that matter, any other airborne viruses in the 21st century.

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- 1 Greenhalgh T, Jimenez JL, Prather KA, Tufekci Z, Fisman D, Schooley R. Ten scientific reasons in support of airborne transmission of SARS-CoV-2. *Lancet* 2021;397:1603-5. doi: 10.1016/S0140-6736(21)00869-2 pmid: 33865497
- 2 Ren J, Wang Y, Liu Q, Liu Y. Numerical Study of Three Ventilation Strategies in a prefabricated COVID-19 inpatient ward. *Build Environ* 2021;188:107467. doi: 10.1016/j.buildenv.2020.107467 pmid: 33223598
- 3 Miller SL, Nazaroff WW, Jimenez JL, et al. Transmission of SARS-CoV-2 by inhalation of respiratory aerosol in the Skagit Valley Chorale superspreading event. *Indoor Air* 2021;31:314-23. doi: 10.1111/ina.12751 pmid: 32979298
- 4 Ou C, Hu S, Luo K, et al. Insufficient ventilation led to a probable long-range airborne transmission of SARS-CoV-2 on two buses. *Build Environ* 2022;207:108414. doi: 10.1016/j.buildenv.2021.108414 pmid: 34629689
- 5 Li Y, Qian H, Hang J, et al. Probable airborne transmission of SARS-CoV-2 in a poorly ventilated restaurant. *Build Environ* 2021;196:107788. doi: 10.1016/j.buildenv.2021.107788 pmid: 33746341
- 6 Tang JW, Bahnfleth WP, Bluysen PM, et al. Dismantling myths on the airborne transmission of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). *J Hosp Infect* 2021;110:89-96. doi: 10.1016/j.jhin.2020.12.022 pmid: 33453351
- 7 Buonanno G, Stabile L, Morawska L. Estimation of airborne viral emission: Quanta emission rate of SARS-CoV-2 for infection risk assessment. *Environ Int* 2020;141:105794. doi: 10.1016/j.envint.2020.105794 pmid: 32416374
- 8 Morawska L, Tang JW, Bahnfleth W, et al. How can airborne transmission of COVID-19 indoors be minimised? *Environ Int* 2020;142:105832. doi: 10.1016/j.envint.2020.105832 pmid: 32521345
- 9 Li Y, Nazaroff WW, Bahnfleth W, Wargocki P, Zhang Y. The COVID-19 pandemic is a global indoor air crisis that should lead to change: A message commemorating 30 years of Indoor Air. *Indoor Air* 2021;31:1683-6. doi: 10.1111/ina.12928 pmid: 34661309
- 10 Ding E, Zhang D, Bluysen PM. Ventilation regimes of school classrooms against airborne transmission of infectious respiratory droplets: A review. *Build Environ* 2022;207:108484doi: 10.1016/j.buildenv.2021.108484.
- 11 WHO. Modes of transmission of virus causing covid-19: implications for IPC precaution recommendations. 2020. www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations.
- 12 Tang JW, Marr LC, Li Y, Dancer SJ. Covid-19 has redefined airborne transmission. *BMJ* 2021;373:n913. doi: 10.1136/bmj.n913 pmid: 33853842
- 13 Dancer SJ. Infection control: Evidence-based common sense. *Infect Dis Health* 2016;21:147-53doi: 10.1016/j.idh.2016.10.003.
- 14 Jimenez J, Marr L, Randall K, et al. Echoes through time: the historical origins of the droplet dogma and its role in the misidentification of airborne respiratory infection transmission.2021. <https://ssrn.com/abstract=3904176>doi: 10.2139/ssrn.3904176.
- 15 Morawska L, Allen J, Bahnfleth W, et al. A paradigm shift to combat indoor respiratory infection. *Science* 2021;372:689-91. doi: 10.1126/science.abg2025 pmid: 33986171
- 16 Balvers J, Bogers R, Jongeneel R, van Kamp I, Boerstra A, van Dijken F. Mechanical ventilation in recently built Dutch homes: technical shortcomings, possibilities for improvement, perceived indoor environment and health effects. *Archit Sci Rev* 2012;55:4-14. doi: 10.1080/00038628.2011.641736.
- 17 Risbeck MJ, Bazant MZ, Jiang Z, Lee YM, Drees KH, Douglas JD. Modeling and multiobjective optimization of indoor airborne disease transmission risk and associated energy consumption for building HVAC systems. *Energy Build* 2021;253:111497. doi: 10.1016/j.enbuild.2021.111497 pmid: 34580563
- 18 Centres for Disease Control and Prevention. Ventilation in buildings. 2021. www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html.
- 19 Bluysen PM, Ortiz M, Zhang D. The effect of a mobile HEPA filter system on 'infectious' aerosols, sound and air velocity in the SenseLab. *Build Environ* 2021;188:107475. doi: 10.1016/j.buildenv.2020.107475 pmid: 33293755
- 20 ASHRAE standard 62.1.2019. Ventilation for acceptable indoor air quality. American Society of Heating, Refrigerating and Air-Conditioning Engineers. www.ashrae.org/technical-resources/book-store/standards-62-1-62-2.
- 21 REHVA. How to operate HVAC and other building service systems to prevent the spread of the coronavirus (SARS-CoV-2) disease (covid-19) in workplaces. April 2021. www.rehva.eu/fileadmin/user_upload/REHVA_COVID-19_guidance_document_V4.1_15042021.pdf.
- 22 WHO. Roadmap to improve and ensure good indoor ventilation in the context of covid-19. www.who.int/publications/i/item/9789240021280.