Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Letter to the Editor

Aerosols should not be defined by distance travelled

Sir,

We read this recent review with disappointment: Bak *et al.*, SARS-CoV-2 routes of transmission and recommendations for preventing acquisition: joint British Infection Association (BIA), Healthcare Infection Society (HIS), Infection Prevention Society (IPS) and Royal College of Pathologists (RCPath) guidance. *Journal of Hospital Infection* 2021 Apr 30:S0195-6701(21)00180-8. https://doi.org/10.1016/j.jhin.2021.04.027 [1].

Although the authors attempted to define the likelihood of transmission routes based on review of the evidence, the overall impression is one of overt bias against the clinical significance of aerosol transmission of SARS-CoV-2. Perhaps more fundamentally, it demonstrates a continuing conflation of distance with mechanism of transmission.

This is particularly manifest in their rather dismissive statement (lines 888–890): "… the Working Party consider that this is an academic argument which is unlikely to reach a consensus. The questions that are important to … users are whether two-metre distance is sufficient and whether respiratory masks designed for filtering airborne particles are necessary to prevent SARS-CoV-2 transmission." We agree that getting guidelines right is important; getting them right requires an accurate assessment of the routes of transmission.

The main issue is the article's outdated and inaccurate use of the terms 'droplets' and 'aerosols' and how these relate to the term 'airborne'. It is of note that the authors continually cite in support of their definition of these terms an 18-year old WHO document on the 2003 SARS-CoV-1 outbreaks, rather than more recent articles that redefine these terms in a way that is more consistent with actual mechanisms of transmission [2,3]. The distinction is important because correctly recognizing the role of aerosols means that mask performance and ventilation should play a role in infection prevention and control.

The term 'droplet' consistent with the original definition of droplet transmission, should refer only to "drops" [2], which are "propelled a short distance through the air," are so large that they "do not remain suspended in the air" [4], and fall to the ground too quickly to be inhaled.

'Aerosols' by definition are suspended in air, i.e. 'airborne'. Essentially, if a person can inhale a suspended particle, whatever the size and whatever the distance from the source (i.e. an infected person in this case), it is an aerosol. The concentration of virus-laden particles will be highest in the plume of exhaled breath released by an infected person while breathing and talking or performing other respiratory activities, thus transmission by aerosols is more likely to occur at short range than at long range.

'Aerosols' can remain 'airborne' for long periods, depending on the local airflow patterns — and can be carried long distances to cause infection at distances greater than 1–2 m. But aerosols can also transmit the virus over short, 1-m conversational, 'garlic breath' distances also, i.e. "within the same room or over longer distance from the source patient" [4]. The distance over which these particles transmit infection should not be used to define them as 'droplets' or as 'airborne'. If they can be inhaled, no matter how far they have travelled, they are aerosols.

Several specific examples in their text also demonstrate other forms of confusion: (1) (lines 369–370) The R_0 is the basic reproductive number, which defines the number of secondary cases produced in a uniformly distributed susceptible population, by a single index case. It does not give any indication of the mode of transmission. For example, a commercial sex worker who is HIV-infected might pass the virus to multiple clients, giving an outbreak-specific R_0 value of 10 for a non-airborne, sexually transmitted infection, which can put it in the same range as varicella zoster virus (which is accepted as an airborne pathogen). (2) The use of the term 'close contact' throughout the article is confusing and ambiguous. Does this mean 'close-range' contact without touching (e.g., asking for directions), or with touch (i.e. shake hands, hug, kiss, etc.)? Aerosol transmission can occur at both short (close) range as well as long range. Close contact is a distance, not a mechanism of transmission. (3) (lines 440–448) Epidemiological evidence of long-range aerosol transmission has been reported in numerous outbreak investigations, especially related to singing [5,6]. It was also the most likely transmission route in a restaurant outbreak [7], where full access to CCTV video demonstrated no visual evidence of fomite transmission. In such ambient airflow-driven outbreaks, you would not expect all people in the vicinity to develop infection — unless the pathogen has time to accumulate sufficiently for everyone to be highly exposed. The important aspect is that aerosol transmission could be both possible and even predominant in these situations.

Finally, returning to their statement on the 'aerosol/airborne/droplet debate' (lines 888–890), given this new aerosol framework and terminology, it is easy to provide guidelines. With regard to SARS-CoV-2 aerosols in well ventilated environments, 2-m distancing is better than 1 m, but not as good as 3 m or more; and surgical masks will reduce

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exposure some, but N95/FFP2/FFP3 will reduce exposure by a lot more [8].

Nothing is absolute and everything is a gradation of exposure risk and protection. Guidance should not over-simplify either, especially as knowledge and experience evolves with this novel, emerging, pandemic pathogen.

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