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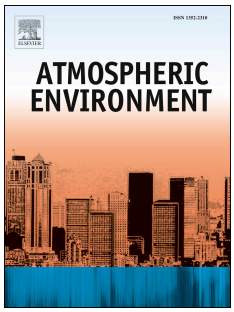

Discussion: Community evidence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission through air. Atmospheric Environment 2020, 118083

Richard J. Pollack, PhD

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Discussion: Community evidence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission through air. Atmospheric Environment 2020, 118083

Richard J. Pollack, PhD
Department of Environmental Health and Safety, Harvard University

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Corresponding Author:
Richard J. Pollack, PhD
Department of Environmental Health and Safety
Harvard University
Cambridge, MA
+1 617 495 2995
richard_pollack@harvard.edu

Central Message: SARS-CoV-2, the viral agent of COVID-19, is transmitted mainly via respirable droplets or aerosols between persons in close contact. Two independent teams explored an outbreak in an apartment building, and proposed and tested scenarios in which presumed virus-laden aerosols might be drawn up through the waste plumbing system to expose and infect the occupants.

Pathogen-laden respirable droplets and particles can pose infection risk via contact with mucus membranes. In the case of SARS-CoV-2 (the agent of COVID-19), currently available epidemiological evidence supports a conclusion that droplets - expelled by an infectious person while coughing, sneezing and breathing - pose greatest likelihood of relevant exposure. Infection risks are greatest when two or more persons are in close proximity for extended intervals, in poorly ventilated spaces, and when masks are not worn.

Guozhen et al in this journal [1], and Kang et al elsewhere [2], described outbreaks of COVID-19 amongst occupants of apartments that were vertically aligned and that shared common waste plumbing systems. Based upon results from contact tracing, travel history of residents, characteristics the building utilities, air flow tracing, computational flow dynamics modeling and viral genomic analyses, authors of both reports implicated the shared waste plumbing as the likely conduit for viral dispersal. Their findings were reminiscent of an earlier report [3] that concluded that plumes of viral-laden aerosols flowing from the waste-plumbing resulted in larger outbreak of SARS in 2003.

Aerosols can be generated and propelled into the air when a toilet is flushed and as the liquid-carried wastes flow within the waste plumbing. Aerosols may also be drawn up – or down – as air passes through the plumbing vents as well as through open drains. Both of the recent reports [1, 2] documented defects in the integrity of the waste plumbing systems that could facilitate air flow into the apartments via dried plumbing traps. Looped waste lines beneath drains are designed to retain or trap water, thereby forming a physical plug between the drain and the waste pipes to which they connect. Such plumbing traps are often required by local building codes to block hazardous sewer gases and foul odors from wafting into living and working spaces. The traps also can block entrance by several kinds of pests that dwell in waste systems. When the traps dry (from evaporation), drain (from cracked or corroded pipes), or are siphoned of water (caused by blockages further upstream in the waste plumbing system), these safety features become compromised.

Both sets of authors [1, 2] modified existing conditions to test their hypotheses that air was drawn up into the apartments via the waste lines and their associated shared vents. Plumbing traps were intentionally drained to mimic predicted conditions at the time of the outbreak. Windows and doors were opened in one study [2] so that exterior winds might exert a Venturi effect to encourage upwards air flow in the waste pipes. Authors of the other study [1] kept windows closed, citing the cool conditions outdoors. Both groups confirmed air flow upwards through the unblocked drains.

Were the waste lines the proverbial ‘smoking guns’ to facilitate dispersal of virus and infection amongst the occupants of other apartments connected via the plumbing? Both sets of authors have provided a possible explanation, but are their proposed scenarios probable?

SARS-CoV-2 RNA has been detected within stools and in wastewater systems [4], but documented reports of infectious SARS-CoV-2 passage and acquisition by this route remain elusive. Because absence of evidence is not the same as evidence of absence, fecal-oral or -respiratory routes cannot be discounted. Assuming virus was present in aerosols arising from the waste system, would it be present in sufficient quantity and in infectious form? The infectious dose of SARS-CoV-2 has not yet been established by any route in human beings, but recent estimates suggest it may require, on average, about 1,000 infectious virus particles [5]. Once aerosolized, SARS-CoV-2 loses infectiousness fairly quickly, with an estimated half-life of about 1.1 hours [6]. Hence, it would seem that a perfect storm of events much occur to facilitate transmission risk by this route.

The appearance of two reports by independent teams of presumed waste plumbing associated outbreaks would seem to argue that this scenario may be more common than anticipated. But, both papers report on the identical outbreak. The two teams apparently operated in parallel or sequence within the same apartments, interviewed the same occupants, and evaluated the same plumbing system. Regardless of one's conclusions, the contribution of aerosols from wastewater plumbing can be minimized by ensuring such systems are properly designed, installed and maintained.

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Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: