Bulletin de veille émissions d'aérosols par l'appareil respiratoire humain N° 32 – Juillet 2026

Objectifs : veille scientifique sur les émissions d'aérosols (gaz et particules) par l'appareil respiratoire humain (nez/bouche).

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Firle C, Stier O, Steinmetz A.

Aerosol emission rates from breathing, speaking, and speaking with a surgical mask.

Front Public Health. 2026;14:13.

https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2026.1833687/pdf

Transmission risk assessment of airborne diseases such as COVID-19 requires a detailed understanding of respiratory aerosol generation and emission during activities such as breathing and speaking, as well as the influence of protective devices such as surgical face masks. We measured integral aerosol emission rates from n = 44 participants during breathing, speaking, and speaking while wearing a surgical mask, with each condition performed for 20 min. All measurements were conducted in a closed 20 m3 cabin under standardized initial conditions in an operating theater environment. Particle emission rates were log-normal distributed across participants. Median emission rates were 60 particles per second (P/s) for breathing (n = 35, IQR 24-152 P/s), 135 P/s for speaking (n = 41, IQR 56-327 P/s), and 278 P/s for speaking with a surgical mask (n = 29, IQR 157-492 P/s). Under the investigated conditions, wearing a surgical mask did not reduce total aerosol emission and was associated with a higher emission rate (median ratio 1.34, 95% CI [1.04-1.75], two clearly separated observations omitted). This observation may be explained by a combination of effects. First, the present measurements reflect total particle emission into the environment and therefore capture system-level behavior, including leakage, rather than material filtration efficiency. Second, previous studies have reported that mask use can alter respiratory mechanics, which may contribute to changes in aerosol emission. These findings may be relevant for assessing long-range transmission risk under comparable environmental conditions. At the same time, they do not contradict the established effectiveness of surgical masks in reducing droplet-mediated short-range transmission.

Huang ZR, Zhong K, Kang YM, Jia HW.

Effects of Flow Field Conditions and Air Supply Parameters on Exhaled Bioaerosols Transport in an Impinging Jet Ventilation Environment.

Aerosol Sci Eng. 2026:21.

https://link.springer.com/article/10.1007/s41810-026-00399-4

The transport and fate of exhaled bioaerosols critically influence respiratory disease transmission. Although impinging jet ventilation (IJV) offered indoor environment control advantages, the transport mechanisms of polydisperse exhaled droplets under different flow conditions (thermally uniform vs. stratified) and their size-dependent response to supply air parameters remained unclear. This study employed the Euler-Lagrange approach to simulate polydisperse droplet transport in IJV environments, quantifying spatiotemporal evolution using droplet number fraction. The results showed that thermal stratification exerted stronger confinement on breathing droplets than coughing droplets. Compared with thermally uniform conditions, suspension fractions increased by 27.7% and 8.3% respectively, indicating higher airborne transmission risk for breathing droplets in thermally stratified IJV. Droplet response exhibited clear size dependence: droplets < 25 mu m followed airflow-dominated trajectories. 50 mu m droplets showed parameter insensitivity due to airflow drag-gravity balance. 75-100 mu m droplets displayed high sensitivity to supply air temperature and humidity within 30 s post-release. Notably, 100 mu m droplets achieved maximum suspension times of 172.2 s and 147.3 s under high supply air temperature (T-s = 28 degrees C) or low humidity (RH = 30%) conditions, highlighting conditional airborne transmission potential of large droplets. These findings provided theoretical basis for optimizing IJV operating parameters and reducing indoor bioaerosol transmission risk. [GRAPHICS]

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Li XJ, Mak CM, Dai YW, Cao SC, Wong HM.

Modulating airborne transmission of respiratory diseases: Effects of saliva rheology on cough fragmentation and aerosol concentration.

Build Environ. 2026;303:10.

https://www.sciencedirect.com/science/article/pii/S0360132326007833?via%3Dihub

The airborne transmission of respiratory diseases is significantly related to saliva aerosolization. Since the rheological properties of human saliva are highly responsive to illness and physiological stress, manipulating these fluid properties in conjunction with environmental control presents a promising strategy for mitigating infection risk. However, many previous studies have simplified respiratory saliva as a surrogate Newtonian liquid. There remains a critical research gap about how individual variations in saliva rheology couple with environmental conditions to influence cough fragmentation, aerosol concentration, and distribution patterns. The present study conducts the in vitro experiments in a climate-controlled chamber using an artificial cough generator and particle image velocimetry (PIV). Seven artificial saliva samples (viscosity: 8 - 27 mPa center dot s, surface tension: 28 - 68 mN center dot m(-1)) are systematically compared under the six different environmental conditions. The results demonstrate that saliva viscosity significantly impacts the fragmentation mechanism, and the variation factor of 3 can reduce the total aerosol concentration to 51-90% of the initial level. While surface tension has minimal influence on the total number of aerosols, lowering it to 28 mN center dot m(-1) promotes the generation of ultrafine aerosols (0.3 mu m). Furthermore, these rheological variations significantly affect the velocity profiles of cough airflow. Relative humidity (RH) has a more substantial *impact on aerosol concentrations compared to ambient temperature, particularly at 40% RH. These findings indicate that integrating individual saliva rheology with environmental controls provides a novel approach to better protect occupants' health in built environments.*

Li YQ, Tang WH, Liu MQ, Li SY, Wu D, Wang YC, et al.

Mechanically driven aerosol emissions from electric toothbrushing: An overlooked indoor source with exposure and infection risk implications.

J Hazard Mater. 2026;515:13.

https://www.sciencedirect.com/science/article/pii/S0304389426019734?via%3Dihub

Indoor aerosol emissions are predominantly attributed to respiratory activities, whereas non-respiratory sources associated with routine hygiene behaviors remain largely overlooked. Here, we investigated aerosol generation during electric toothbrushing through 1290 controlled chamber tests involving human participants. Results showed that emissions were dominated by respirable fine particles, with over 85% below 2.5 mu m, while ultrafine particle levels showed no clear increase relative to the pre-brushing baseline, indicating a distinct emission regime compared to respiratory processes. Emission dynamics exhibited structured temporal patterns with sustained release, rather than short-lived bursts. Across device-, product-, and subject-level factors, aerosol generation was primarily governed by toothbrush mechanics, with sonic toothbrushes producing consistently higher emissions than oscillating-rotating types, highlighting the role of bristle vibration frequency and amplitude, whereas toothpaste formulation showed secondary, mechanism-dependent effects, and interindividual variability remained negligible. These findings suggest that mechanically induced liquid-film disruption dominates aerosol formation. Measured emission rates were comparable to those from speaking and approached the lower range of singing. Dose-response modeling further indicated that, under assumed pathogen concentrations and aerosol viability conditions, high-emission sonic brushing could produce modeled relative infection-risk estimates comparable to speaking, while Monte Carlo rank analysis placed it among the higher-ranked activity scenarios below singing. Notably, subjective perception did not reflect measured emissions, indicating an unrecognized exposure pathway. Overall, electric toothbrushing is identified as a previously

Lu JQ, Chen XD, Ding X, Liu YC, Zhong JL, Liu F, et al.

Flying Droplet Sensor Based on H-GQDs/CNF Network Structure and Its Applications.

ACS Sens. 2026;11(7):6157-66.

https://doi.org/10.1021/acssensors.6c01218

Respiratory infectious diseases continue to pose a serious threat to public health. Their transmission relies on respiratory droplets that are small in size and evaporate rapidly, making real-time monitoring difficult. In this study, we propose a flying droplet sensor based on hydroxylated graphene quantum dots (H-GQDs) deposited on a cellulose nanofiber (CNF) film. Owing to the network water-locking structure of the film, the sensor is capable of detecting coughing droplets transmitting over long distances (>= 2.4 m). By placing multiple such sensors at equal intervals along the cough airflow direction, the spatiotemporal transmission features of coughing droplets were obtained, including arrival time and signal intensity at different distances. On this basis, we investigated the transmission behavior of cough droplets from multiple individuals at various distances. The results show that regions close to the volunteer's mouth exhibit a broader droplet size distribution, whereas at longer distances, *the remaining droplets are mainly composed of small-size and low-intensity components. We further found that coughing droplets typically take 4-5 s to travel more than 2 m, indicating that a time window for timely protection still exists at this distance. In addition, the relationships between cough sound level and droplet signal intensity as well as transmission time were evaluated. No clear correlation was observed, suggesting that acoustic indicators alone cannot directly reflect the infection risk associated with cough droplet transmission. This study provides important insights for the real-time monitoring and protection against respiratory droplet transmission.*