
# Bulletin de veille AéroCovid
# N°132 – 25/02/2026

Objectif : *Air intérieur, ventilation, climatisation et propagation du Covid-19*

*La validation des informations fournies (exactitude, fiabilité, pertinence par rapport aux principes de prévention, etc.) est du ressort des auteurs des articles signalés dans la veille. Les informations ne sont pas le reflet de la position de l'INRS. Les éléments issus de cette veille sont founis sans garantie d'exhaustivité.*

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# Google Scholar, Lens et WoS

Hernández-Cruza, B. K., Tapia-Becerraa, M. T., Hernández-Castilloa, O., De, A. J., Los Santos-Salinasa, V. M. Á.

**Comparación de las comunidades bacterianas y fúngicas del aire interior y exterior en un Hospital General de Zona en el Estado de México en la temporada Seca Fría (Comparaison des communautés bactériennes et fongiques présentes dans l'air intérieur et extérieur d'un hôpital général régional de l'État de Mexico pendant la saison sèche et froide).**

Memorias del VI Simposium Iberoamericano de Nanotecnología y Calidad Ambiental 2025

Microorganisms are transmitted through the air in the form of bioaerosols, constituting a significant fraction of fine particulate matter (PM2.5) and linked to healthcare-associated infections (HAIs). This study evaluated the indoor air quality in a General Hospital during the cold-dry season (November 2024 - February 2025). Microclimatic parameters were monitored, and 196 bioaerosol samples were collected at 49 locations using a single-stage Andersen sampler. Results revealed variable relative humidity and microbial concentrations that exceeded recommended limits, with maximums of 553 CFU/m³ for fungi and 884 CFU/m³ for bacteria. The analysis identified the predominance of Gram-positive bacteria (cocci) and fungi of the genera Cladosporium and Penicillium. It is concluded that there is widespread microbiological contamination, which highlights the need to optimize climate control systems to mitigate the risk of HAIs.

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Chávez, R. N., Castillo, O. H., Reyes, C. a. M., Itzel, M., Campero, D., Álvarez, V. M.

**Diversidad microbiana en el aire en un centro de salud de primer nivel: identificación de bacterias y hongos (Diversité microbienne dans l'air d'un centre de santé de premier niveau : identification des bactéries et des champignons).**

Memorias del VI Simposium Iberoamericano de Nanotecnología y Calidad Ambiental

Bioaerosols are airborne biological particles—primarily bacteria and fungi—that influence air quality and contribute to Healthcare-Associated Infections (HAIs). This study analyzed the presence of bioaerosols in a Family Medicine Unit (UMF). A total of 176 samples were collected during the dry-cold (SF) and dry-warm (SC) seasons using a single-stage Andersen impactor. Bacterial concentrations ranged from 433–455 CFU/m³ in SF and 301–389 CFU/m³ in SC. Fungal levels ranged from 338–540 CFU/m³ in SF and 205–220 CFU/m³ in SC, remaining mostly within the limits suggested by the World Health Organization. A total of 50 bacterial isolates were identified, with a predominance of Gram-positive species (60%), and 112 fungal isolates were obtained, with Penicillium spp. being the most common genus (32%).

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Qian, Y., Ji, J., Xie, H., Li, J., Xu, S., Jia, H., *et al.*

**Experimental study and numerical analysis on the disinfection of exhaled bioaerosols by Trombe wall in a mechanically ventilated environment.**

Building and Environment, Vol. **293**, (2026)

The air-purifying Trombe wall delivers combined benefits for energy utilization and indoor air quality improvement while operating without external energy input, thereby representing a zero-energy building envelope tailored to post-pandemic scenarios that demand both energy conservation and effective bioaerosol control. However, current research remains primarily at the conceptual stage, and the available evaluations are confined to system-level analyses. Its performance against exhaled bioaerosols under realistic conditions remains underexplored, especially in ventilated rooms. In this study, a bioaerosol test chamber integrated with the proposed system was constructed to evaluate full-day thermal efficiency and purification efficacy, using Escherichia coli as a surrogate. Thermal inactivation kinetics were identified via particle swarm optimization (PSO)–based fitting. The spatiotemporal evolution of mannequin-exhaled bioaerosols was characterized at typical air-change rates (ACH), while a computational fluid dynamics model was employed to quantify the effects of ventilation condition and solar irradiance on bioaerosol transport. Results show that, on the experimental day, the system supplied approximately 99.35 m3 of clean air and delivered 9.6 MJ of space-heating energy. With ventilation at 0, 3, and 6 ACH, indoor bioaerosol concentrations remained low when the system operated, but the incremental purification benefit decreased as ventilation increased. Higher irradiance reduced the indoor bioaerosol concentration and reshaped the upper-outlet flow pattern, thereby modulating bioaerosol transport. The upward-supply/downward-return mode is more suitable for indoor environments equipped with proposed system. Surface deposition patterns identify the ceiling and the south wall as priority zones for disinfection.

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Choi, Y., Kim, S., Kim, D.

[Machine learning-integrated metal-organic frameworks/multi-walled carbon nanotubes sensor array for real-time detection of fungal VOCs.]()

<u>Journal of Hazardous Materials</u>, Vol. **505**, (2026)

Biological hazards posed by indoor fungi present significant challenges due to their hidden growth and the limitations of conventional detection methods. As an alternative, microbial volatile organic compounds (MVOCs) offer a non-invasive proxy for early-stage fungal contamination. This study presents a multi-modal gas sensor platform integrating metal-organic framework (MOF)/multi-walled carbon nanotube (MWCNT) composites with machine learning algorithms for real-time MVOC detection. Three MOF/MWCNT composites—ZIF-8/MWCNT, Cu-BTC/MWCNT, and UiO-66/MWCNT—were coated on three sensor types: quartz crystal microbalance (QCM), resistive sensor (RS), and electrochemical impedance spectroscopy (EIS). The sensor array was evaluated through exposure to single compounds, gas mixtures, and headspace emissions from common indoor fungi (i.e., Aspergillus, Cladosporium, and Penicillium). Ethanol, 2-butanone, and benzene were selected as test compounds. For single-gas detection, the random forest classification model achieved 95 % accuracy. For gas mixtures, the CatBoost regression model yielded $R^2$ values of 0.59 (ethanol), 0.93 (2-butanone), and 0.79 (benzene). Headspace sampling from fungal cultures enabled accurate classification of fungal emission versus control samples, achieving a classification accuracy of 0.963 using the Catboost model. These results confirm the feasibility of indirect, data-driven fungal detection using gas-phase signals. This work demonstrates a proof-of-concept sensing platform that holds promise for scalable and adaptive applications in indoor air quality monitoring. Future efforts will focus on scaling up MOF-composite synthesis and developing portable devices for early warning of microbial contamination in high-risk environments.

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Gupta, A. K., Thamida, S. K.

[Numerical tracing of microbial particles in a compact thermal air sterilizer with recirculation.]()

<u>Thermal Science and Engineering Progress</u>, Vol. **71**, (2026)

This study presents the development and validation of a thermally regulated air sterilization system featuring adaptive temperature control and air recirculation, targeting airborne transmission of infectious diseases such as tuberculosis and COVID-19. The device employs a tunable outlet air temperature to meet pathogen-specific inactivation requirements, enabling versatile microbial control. Computational Fluid Dynamics (CFD) simulations in COMSOL Multiphysics, emphasizing discrete phase particle tracking, were used to analyze thermal and air flow behaviour in three different prototypes: baseline normal, L-shaped and elliptical. The elliptical design demonstrated superior performance, yielding a 50% increase in average particle residence time (17.39 sec) and a 4.27-fold rise in recirculation frequency (15.81 cycles) relative to the basic design. Additionally, the elliptical model achieved 70% droplet passage through the 65°C inactivation zone, compared to 50% for alternative geometries. Prototype operation exhibited thermal steady state duration ranging from 25 min (closed-inlet) to 60 min (open-inlet), while maintaining a constant wall heat flux (4545 W/m2) and the inline blower static pressure head at 25 Pa. Experimental validation resulted in a less root mean square error of below 5°C between measured and simulated temperatures, confirming model fidelity. Microbial inactivation was further substantiated by low optical density (OD600) of nutrient medium exposed to treated air at 0.001 units which is markedly below the value of 2 units observed for untreated room air. The simulations establish that the elliptical shaped prototype is a better and effective design for robust, energy-efficient and reliable indoor air sterilization.

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Cho, J., Song, J.

**Rapid-Deployment Negative Pressure Isolation Units: Design Approach and System Development.**

ASHRAE Journal, Vol. **68** n°(2), (2026)

Increased frequency of infectious disease outbreaks underscores the need for rapidly deployable medical isolation facilities that can ensure infection control while maintaining health-care capacity. Part 1 of this two-part series presents the conceptual framework and design methodology for modular negative pressure isolation rooms (MNPIR) developed for pandemic response.

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Ren, Z., Li, X., Ma, S., Kim, J. I.

**Risk-aware robotic infection control: Integrating computer vision and physics-informed decision-making for resilient ventilation in offices.**

Developments in the Built Environment, Vol. **25**, (2026)

This study proposes a risk-aware robotic personalized ventilation framework that adaptively relocates a mobile air purifier to reduce airborne infection risk in offices. The system integrates computer vision-based occupancy sensing, a physics-informed surrogate model that predicts infection risk by learning single-source computational fluid dynamics (CFD) scalar transport fields and reconstructing multi-occupant conditions via linear superposition, and uncertainty-aware decision-making under infection-source uncertainty among detected occupants. Evaluated in a university meeting room, the surrogate achieves a mean absolute error of 0.77% in infection probability on blind test scenarios, significantly outperforming purely data-driven algorithms. Across 255 occupancy configurations, results reveal a Pareto conflict between aggregate cleaning efficiency and individual safety equity, motivating an adaptive planner that switches between risk-neutral and risk-averse policies. Compared with static baselines, the proposed strategy reduces mean risk by 35.5% and up to 74% in worst-case exposure. On-site prototype trials demonstrate a scalable, low-latency solution for upgrading indoor safety.

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Zhang, S., Jiang, J., Cheng, Y., Lin, Z.

**Ventilation Performance Indices with Elevated Air Movement for Health, Thermal Comfort, and Energy Efficiency.**

Springer; 2026

This book introduces new indices catered for elevated air movement for systematic ventilation performance evaluations regarding thermal comfort, indoor air quality, and energy efficiency. Elevated air movement of ventilation system is polarized for energy-efficient creation of thermally comfortable and healthy indoor environments as a sustainable solution to climate change and respiratory diseases. While ventilation performance indices are indispensable for the proper design and operation of ventilation system, elevated air movement challenges the traditional ventilation performance indices designed for low air movement. The cooling effect of air movement on thermal comfort and energy efficiency and the contaminant dilution and removal effects of ventilation on airborne infection risk control are particularly highlighted. The book is intended for undergraduate and graduate students, researchers, and engineers who are interested in cutting-edge technologies for sustainable and healthy built environments.

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