

Bulletin de veille Maladies aéroportées N°6 – 18/11/26

Objectif : *Air intérieur, ventilation, climatisation et propagation des maladies aéroportées*

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Google Scholar, Lens et WoS

Arandjelović, I., Mijatović, S., Ilić, A., Trajković, J., Stanković, J. A., Gobeljić, B.*, et al.*

Effect of Carbon-Fiber Negative Air Ionization (NAI) on Air Sampled in a Pediatric Hospital: Culturable Airborne Bacteria, Species Diversity, and Biofilm Formation.

In: Microorganisms. 2026. pp. 2560.

Bioaerosols in hospital air pose a threat of respiratory infections, particularly among immunocompromised patients. Abating their effects by diverse methods proposed for air purification remains an open topic. In particular, low environmental bioaerosol concentrations, alongside species diversity, make such studies more difficult. We designed environmental indoor air samplers aimed at: (i) direct collection and quantification of culturable airborne bacteria from a selected location and (ii) accurate evaluation of effects of negative air ions (NAIs) on airborne bacteria. We studied ion–bioaerosol interaction in three distinct pediatric hospital departments by collecting non-treated (NTAS) and ion-treated (ITAS) samples side by side. Air was sampled at 0.5 m/s for 90 min (68.7 m3), with airborne bacteria collected directly onto chromogenic media. NTASs were dominated by Micrococcus luteus (58.27%), Staphylococcus hominis (15.56%), and S. haemolyticus (10.37%). ITASs were dominated by M. luteus (38.73%), S. haemolyticus (20.42%), S. hominis (12.68%), and S. warneri (11.27%). Overall, bacterial counts were 1.37–6.13-fold higher in NTASs than in ITASs across isolated species, indicating a substantial reduction in culturable airborne bacteria following NAI treatment. These findings show the promise of carbon-fiber-based NAI technology as a complementary approach to improving hospital air quality and reducing airborne bacterial contamination.

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Harenne, C., Kesseler, S., Pitti, P., Lamtiri, M., Bertrand, A., Lisson, M.*, et al.*

Environmental circulation of airborne SARS-CoV-2 particles in intensive care rooms.

Research Square, (2026)

Airborne transmission is a major concern in intensive care units (ICUs). This study aimed to identify the determinants of airborne and surface contamination in ICU rooms occupied by patients with COVID-19 associated respiratory failure.

Observational study in a tertiary care hospital comprising six ICUs with diverse architectural layouts and HVAC systems. We modeled the dispersion of respiratory particles in five rooms using computational fluid dynamics (CFD). Air and surface samples were collected at predefined locations in 19 rooms occupied by 28 patients testing positive for SARS-CoV-2. Risk factors associated with environmental contamination were identified using classification tree analysis.

Measured HVAC airflow rates were substantially lower than programmed values in three ICUs. CFD simulations suggested that exhaled particles initially rose above the patient, accumulated beneath the ceiling, and subsequently dispersed in the room. SARS-CoV-2 was detected in 14/64 (22%) air samples and 60/134 (45%) surface samples. The most important determinants of environmental contamination were patient viral load, room characteristics, and mode of respiratory support. Environmental contamination was more frequent in rooms with low airflow rates and extraction vents located outside the room.

In our ICUs, the main factors associated with environmental detection of SARS-CoV-2 particles were patient airway viral load, the flow rate and location of the exhaust ventilation system, and the use of

mechanical ventilation. These results could help guide the renovation or construction of intensive care rooms.

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Adjal, A., Nicolici, V.-S., Ionel, I.

Experimental and Numerical Insights into Indoor Contaminant Transport and Ventilation Performance: A Review.

Eng, Vol. **7** n°(11), (2026)

Indoor air quality depends on how airflow, buoyancy, and turbulence transport contaminants through occupied spaces. However, experimental diagnostics and computational fluid dynamics (CFD) are often applied in isolation. This review examines how the two can mutually constrain predictions of indoor contaminant transport and ventilation performance. A structured narrative review of Web of Science, Scopus, ScienceDirect, IEEE Xplore, and PubMed focused on studies published between 2020 and 2026, complemented by earlier benchmark studies. The evidence covers contaminant physics, flow and tracer-gas diagnostics, turbulence and multiphase modeling, ventilation strategies and metrics, and data-driven and digital-twin approaches. Probe intrusiveness and non-passive tracer behavior bias measured ventilation indices. Isotropic Reynolds-averaged Navier–Stokes (RANS) closures, such as standard k-ε, misrepresent buoyant plumes and overpredict near-wall particle deposition. The shear stress transport (SST) k-ω model and large eddy simulation (LES) improve fidelity at increased computational cost. Bulk air-change rates do not reflect breathing-zone exposure. Surrogate models and digital twins inherit the errors of insufficiently validated CFD training data. Key gaps include dynamic occupancy, unstandardized respiratory source terms, and inconsistent reporting of boundary conditions, grid verification, and measurement uncertainty. A hierarchical measurement–CFD–artificial intelligence (AI) validation framework is proposed to support the design of exposure-oriented ventilation, adaptive control, and energy-efficient operation.

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Thanatrakolsri, P., Tammawong, N., Arworn, S., Srikam, S., Ivanovitch, K., Norkeaw, S.

An Exploratory Comparison of Indoor Air Quality and Culturable Airborne Microbial Concentrations Among Hospital Waiting Areas With Different Ventilation Conditions in Northern Thailand.

Environmental Health Insights, Vol. **20**, (2026)

Few studies have simultaneously characterized physical, chemical, and culturable biological indoor air quality (IAQ) in hospital waiting areas, particularly in tropical healthcare settings. This exploratory observational environmental monitoring study assessed PM2.5, PM10, CO2, CO, thermal environmental parameters, and culturable airborne bacterial and fungal concentrations in five hospital waiting areas with different ventilation conditions in Northern Thailand. Measurements were conducted over nine sampling days and summarized at the room-day level to account for repeated spatial measurements. Significant overall differences among waiting areas were observed for PM10 ($p = 0.0012$), temperature ($p = 0.0006$), culturable bacteria ($p = 0.0050$), and culturable fungi ($p = 0.0007$), whereas PM2.5, relative humidity, CO, and CO2 did not differ significantly at $p < 0.01$. No pairwise comparison remained significant after Holm adjustment. Descriptively, Room E, the only mechanically ventilated waiting area, generally showed lower PM10 and culturable bioaerosol concentrations than several naturally ventilated waiting areas; however, these differences cannot be attributed exclusively to ventilation condition because mechanical ventilation was represented by only one room. Neither mixed-effects models (bacteria: $p = 0.062$; fungi: $p = 0.153$) nor room/day fixed-effects sensitivity analyses (bacteria: $p = 0.542$; fungi: $p = 0.447$) showed significant associations between PM10 and culturable bacterial or fungal concentrations. These findings demonstrate substantial room-specific heterogeneity in IAQ and provide a site-specific baseline for future multi-site studies and targeted ventilation, filtration, and IAQ management strategies in hospital waiting areas.

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Takari, A., Hamadanian, M.

RSM-optimized ternary Ag-Cu-Zn nanocolloid-based air filters: PM removal efficiency and antibacterial performance compared with ESP/ionizer technologies.

Journal of Hazardous Materials, Vol. **518**, (2026)

Developing air filters that efficiently capture fine particulate matter (PM) while eliminating harmful pathogens without compromising airflow remains a critical challenge in environmental management. To address this limitation, we engineered a scalable, enzyme-free multifunctional nanocolloid-coated fibrous filters (nanofilter) functionalized with a ternary Ag/Cu/Zn nanocolloid coating on polyester (PS) and microfiberglass (FG) substrates. Using response surface methodology and multivariate analysis of variance (ANOVA), the formulation was optimized at concentrations of 807 ppm (Ag), 797 ppm (Cu), and 203 ppm (Zn), with optimized relative nanocolloid application levels of 350% on PS and 400% on FG. The optimized nanofilters exhibited antibacterial performance against Escherichia coli and Staphylococcus aureus under UVC-assisted conditions, with no viable colonies detected under the applied experimental conditions. Furthermore, the coated filters improved particulate capture under the evaluated conditions, yielding total mass gains of 4.80 mg (PS) and 10.24 mg (FG) while maintaining low pressure-drop characteristics (<2 Pa at 32 L/min). This ternary Ag/Cu/Zn-based multicomponent platform provides a multifunctional air-cleaning approach by integrating particulate capture with antibacterial activity, offering complementary advantages compared with conventional electrostatic and plasma-based technologies.

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