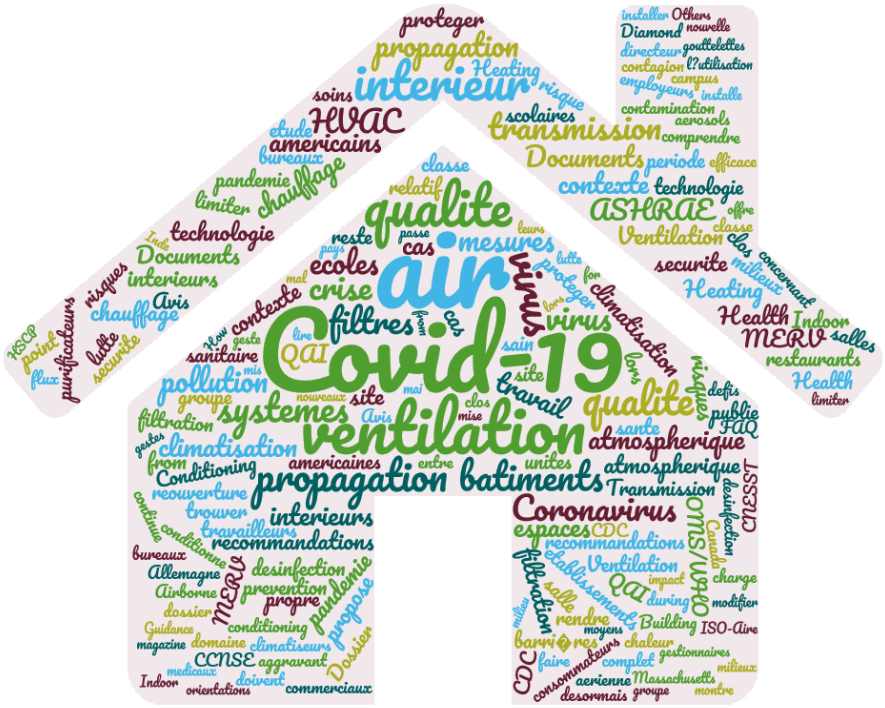

Bulletin de veille AéroCovid
N°135 – 08/04/2026

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.

Les liens mentionnés dans le bulletin donnent accès aux documents sous réserve d'un abonnement à la ressource.

Les bulletins de veille sont disponibles sur le portail documentaire de l'INRS. L'abonnement permet de recevoir une alerte mail lors de la publication d'un nouveau bulletin (bouton « M'abonner » disponible après connection à son compte).

Google Scholar, Lens et WoS

Arif, S., Vuddandi, S. P.

Chap 18 : Infection Control during pandemics and outbreaks.

In: Safeguarding The Critically Ill. JP Medical Ltd; 2026.

Pandemics will continue to force critical care units to act outside their normal processes. The practices are drawn from the existing Centers for Disease Control and Prevention (CDC) recommendations and represent fundamental standards of care that are not expected to change based on emerging evidence or technology or practice changes and are applicable across the continuum of healthcare settings. Intensive care units (ICUs) face significant challenges in infection control, requiring a multidisciplinary approach, heightened awareness, and constant vigilance among healthcare workers (HCW).

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Bhutada, K. P.

Chap 21 : Intensive Care Unit Layout and Design for Infection Prevention.

In: Safeguarding The Critically Ill. JP Medical Ltd; 2026.

The proportion of intensive care unit (ICU) beds in a hospital typically ranges from< 10% to as high as 30% of the total number of hospital beds; however, infections acquired in the ICU account for a large proportion of nosocomial infections. The various nosocomial infections in the ICU are catheter-related bloodstream infections (CRBSIs), ventilator-associated events (VAEs), including ventilator-associated pneumonia (VAP), and catheter-associated urinary tract infections. These infections contribute to increased length of stay in the ICU, morbidity, and mortality. The rate of infections is higher in resource-limited countries like India than in developed countries. A multicenter prospective cohort surveillance study conducted across 46 hospitals in Central and South America, India, Morocco, and Turkey revealed an overall infection rate of 14.7%(or 22.5 infections per 1,000 ICU days), significantly higher than infection rates in developed countries. A subsequent study by the same international group reported results from 98 ICUs from Latin America, Asia, Africa, and Europe. Even though device utilization was remarkably similar to that reported from ICUs in the United States, rates of device-associated nosocomial infection were markedly higher in the ICUs from resource-limited countries.

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Azid, A., Hassan, A., Samsudin, M. S., Rani, N. L. A., Ali, N. I. M.

Chapter 7 : Air purification and indoor air quality of green microbial nanotechnology for pollution control.

In: Green Microbial Nanotechnology for Pollution Control. Elsevier; 2026. 169-215 p.

Indoor air pollution has emerged as a critical public health concern due to its profound impact on human well-being and the environment. This chapter explores the integration of green microbial nanotechnology for the advancement of air purification and indoor air quality (IAQ) management. It provides an overview of major indoor pollutants, including volatile organic compounds, particulate matter, bioaerosols, and hazardous gases, and their associated health risks. Emphasis is placed on the innovative use of biologically synthesized nanoparticles (NPs), which offer a sustainable and highly effective approach to pollutant mitigation due to their unique physicochemical properties. The chapter elaborates on microbial biosynthesis mechanisms, the role of capping agents, and the diverse types of microorganisms, including bacteria, fungi, algae, yeast, viruses, and actinomycetes, employed for nanomaterial production. Furthermore, it discusses the catalytic applications of microbial NPs in degrading dyes, nitrophenols, and chlorinated compounds. The integration of microbial enzyme technology with nanomaterials for enhanced

bioremediation is also highlighted. In addition, the emergence of nanotechnology-driven sensors and nanobiosensors for real-time air pollution monitoring is reviewed, showcasing their potential to revolutionize IAQ management. Finally, the chapter presents advanced strategies involving filtration systems, adsorption techniques, and monitoring devices based on green nanomaterials to enhance indoor air purification. The collective insights presented underscore the transformative role of green microbial nanotechnology in addressing indoor air pollution challenges and promoting healthier indoor environments.

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Vargas-Maldonado, N., Shetty, N., Ferreri, L. M., Pauly, M. D., Patatanian, K., Danzy, S.*, et al.*

Controlled human influenza infection reveals heterogeneous expulsion of infectious virus into air.

Cell, (2026)

Summary Influenza virus is transmitted via respiratory expulsions, but detecting infectious virus in expulsions is challenging. Here, we describe quantification and genotyping of infectious virus in respiratory particles using a modular influenza sampling tunnel (MIST). The particles deposit on cell monolayers, enabling culture, quantification, and sequencing of viruses. Concomitantly, water-sensitive paper and fine particle samplers yield respiratory particle counts over a broad size range. Using the MIST, we captured infectious virus from humans experimentally infected with the influenza virus on multiple days post-inoculation. The recovered respiratory particles varied in quantity over three orders of magnitude and contained viral variants also detected in samples from infected individuals. Expulsion of infectious virus was associated with infectious viral load in saliva and nasopharyngeal swabs and with clinical symptoms. These data reveal maintenance of viral diversity in expelled aerosols and suggest heterogeneity among individuals in the magnitude of infectious expulsions, impacting forward transmission potential.

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Kowalski, W.

DaVita White Paper: Design and Installation of UV Air Purifying Systems in the DaVita Dialysis Centers.

Infection Prevention technologies, Inc. 2026.

The DaVita Clinic in Kalamazoo (West #2287) is used as a model for the evaluation of installation of a UV air disinfection system for other DaVita locations. The planned retrofit consists of six UV400 units from UV Flu Technology, Inc. These units have been previously evaluated to produce a UV Dose of 41 J/m2. It is the intent of this system to reduce or eliminate potential contamination hazards produced by pathogens and fungal spores that hail from the ambient or indoor environment and may contaminate e dialysis machines. The three most common fungi of concern in healthcare are Aspergillus species (spp.), Histoplasma capsulatum, and Cryptococcus neoformans. The DaVita clinic is modeled as a volume with internal supply air and 15% outdoor air. Analysis of all three microbial groups, bacteria, viruses, and fungi indicate high removal rates are possible for all types of pathogens. Analysis of the three subject fungal spores indicate that airborne concentrations of each of them can be reduced to less than 10 cfu/m3 within five hours, and that this level of cleanliness can be maintained indefinitely. This level of air cleanliness would be at least equal to that of typical hospital environments where measured fungi levels are often about 50 cfu/m3 or higher. The application of the UV400 units to the clinic should therefore be highly effective at eliminating potential health hazards and equipment contamination concerns.

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Xu, R., Wu, F., Shen, L., Pan, X., Nie, C., Huang, Y.*, et al.*

Improving hybrid ventilation via HVAC system control for indoor air quality, thermal comfort and energy performance in a high-speed train cabin.

Applied Thermal Engineering, Vol., (2026), 130799 p.

In the post-pandemic era, improving ventilation in enclosed high-speed train cabins is crucial for reducing airborne transmission while maintaining thermal comfort and energy efficiency. To address this need, this study employs numerical simulations to systematically investigate the impact of coordinated control between the fresh air ratio and the air supply mode on cabin ventilation performance. Full-scale experiments are conducted to provide high-fidelity validation of the simulations. The results show that, for both sidewall and top air supply modes, the total number of deposited particles in the cabin levels off when the fresh air ratio exceeds 37.5%, and further increases lead to only minor changes in overall deposition. Furthermore, the fresh air ratio demonstrates a strong linear relationship with particle accumulation on passenger surfaces ($R > 0.97$). Thermal comfort and energy consumption are primarily dependent on the fresh air ratio and air supply mode. Under low fresh air settings, the top air supply mode achieves relatively favorable thermal comfort, with an average predicted mean vote (PMV) ranging from −0.55 to 0, but may still pose a risk of draught discomfort around the passenger head region. In contrast, the sidewall air supply mode mitigates airflow fluctuations in the occupied zone and decreases energy use by approximately 12.4% to 14.9%. These results indicate that a balanced cabin environment in high-speed trains cannot be achieved consistently through a single adjustment, and coordinated tuning of the fresh air ratio and air supply mode is therefore required.

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Vukotić, A., Mesihović, A., Semić, A., Karakaš, S., Mulić, M.

Influence of Air Conditioning Devices Age, Distribution Installation Materials, Maintenance and Dynamics of Use on the Appearance of Legionella: A Study Conducted in the Territory of the Federation of Bosnia and Herzegovina.

Aim and Scope, (2026), 24 p.

Because man strives to ensure the comfort in living and working spaces, there is a lot of air conditioning devices to achieve the desired temperature. Bacteria from the genus Legionella is a pathogenic bacterium that can cause the disease to occur in very severe form. It most often inhabits water systems created by human activity, among which are air conditioning devices, which is why there is a need to test factors that favors bacteria colonization. The study included 79 facilities from the territory of the Federation of Bosnia and Herzegovina of which 42 or 53.2% facilities with centralized, and 37 or 46.8% facilities with individual air conditioning devices. Data were collectedusing a survey and laboratory analysis of samples. The analysis was performed individually, taking into account thedifferent requirements and complexity of the two types of air conditioning devices. The objectives were related to thecorrelation between the age, distribution installation material, project, the maintenance dynamics and the need to use the air conditioner with Legionella spp. colonization. The results indicate a positive influence of the air conditionerage and steel distribution installation on the Legionella spp. colonization. Significant correlation was not observed between the collected survey responses (project, maintenance and the air conditioner use frequency) and the Legionel-la spp. colonization. The identification of factors that positively correlate with the presence of Legionella spp. in airconditioning devices has significant public health and technical contribution, especially in the context of legionellosisprevention

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Sormunen, P., Lastovets, N., Ehder-Gahm, I., Kulmala, I., Luoto, A., Säämänen, A.

Life-cycle cost comparison of portable air cleaners and ventilation systems for respiratory infection control in a daycare centre.

Energy and Buildings, Vol. **360**, (2026)

Ensuring a healthy indoor air environment in daycare settings is important because children are more susceptible to airborne infections and spend time indoors in a crowded space. However, limited resources and existing ventilation system constraints challenge the implementation of effective infection-control strategies. This study analyses life-cycle costs (LCC) of three different methods to improve indoor air quality in a daycare with mechanical ventilation: (1) enhancing the mechanical ventilation system, (2)

purchasing portable air cleaners (PACs), and (3) renting PACs. The clean air delivery target was normalised across all cases to compare additional investment, energy and maintenance costs. The results show that purchasing PACs at mid-range unit price (4 € per (m3/h) CADR) provides up to 70% lower LCC than enhancing mechanical ventilation, especially in contexts where enhancing mechanical ventilation airflow rate is not feasible. Short-term PAC rental solutions are cost-effective for high-risk periods, offering up to 80% lower costs for a one-year deployment, although rental costs rose sharply over longer durations, finally surpassing PAC purchase costs. Enhanced mechanical ventilation required higher capital and energy costs as well as space needs in technical spaces and systems. The sensitivity analyses showed that the cost ranking remained stable across a reasonable range of unit prices, energy tariffs, discount rates, and system lifetimes. This study addresses a notable research gap by providing a direct, normalised life-cycle cost comparison between portable air purification and mechanical ventilation in a daycare setting. The findings support hybrid infection control strategies combining PACs and mechanical ventilation solutions based on local needs, building type, and risk profile.

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Suswati, I., Maulida, A. P.

Measurement of Airborne Bacterial Colonies Upon Cleaning a Factory Worker Area.

KnE Medicine, Vol. **4** n°(1), (2026), 246 - 252 p.

Background: Bioaerosols are airborne microorganisms that consist of dust particles formed from organisms or their remains. Indoor air could contain a higher quantity of pollutants than outdoor air. Indoor air pollution is a primary concern that can lead to health issues for workers. Considering the biological exposure in the workplace, it is crucial to evaluate the impact of cleaning workers' areas by measuring the concentration of airborne bacterial colonies before and after the cleaning process.
Objective: To determine the effect of cleaning workers' areas on the prevalence of airborne bacterial colonies.
Method: Determine the number of employee workspaces utilized for service, organize supplies and equipment for the assessment of airborne bacterial colonies, and conduct an evaluation of the airborne bacterial colony count following the cleanliness of employee workspaces.
Results: Employee workspace cleaning is conducted continually without a specified timeframe, but production equipment operates around the clock. The smallest number of colonies observed in the packing room was 5, but the maximum recorded in the production administration room was 248. The increase of airborne microorganisms is associated with staff activity, the number of personnel, and spatial dimensions. Macroscopically, the multiplication of airborne bacteria was accompanied by the observation of fungal development in the baling room and warehouse. The staining results indicate that the Gram-positive rods likely belong to the Bacillus or Clostridium genera. The number of airborne colonies is associated with activity levels, workforce size, spatial dimensions, and the bacterial species from the Bacillus or Clostridium genera.

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Dendup, P., Subba, K., Dorji, S. G.

Mitigating Airborne Occupational Hazards In Passaka's Industries In Bhutan: A Policy Brief On Enhancing Worker Health, Productivity, And Sustainable Economic Development.

International Journal of Preventive, Curative & Community Medicine, Vol. **12** n°(1), (2026), 25-33 p.

Background: Bhutan's industrial growth, especially in Pasakha, createssignificant occupational health and safety (OHS) challenges, particularlyfrom airborne hazards. A lack of localized data hinders effective OHSpolicy development. This study addresses this gap by assessing airbornehazard exposure in selected Chukha Dzongkhag industries to informnational OHS strategies.Methodology: Twenty-seven air samples were collected over 30-minuteperiods from 14 workplaces across seven industrial sectors. Sampleswere analyzed by an internationally accredited laboratory for 17parameters including particulate matter (PM10, PM2.5), formaldehyde,heavy metals (lead, arsenic, chromium), and silica. Results werecompared against Bhutan's 2022 OHS Regulation and internationalstandards (OSHA, NIOSH, ACGIH).Results: Findings show widespread exceedances of permissible exposurelimits (PELs). Formaldehyde reached 1.11 ppm in

plastics (PEL: 1.0ppm). PM10 hit 1,165 µg/m³ in metals (PEL: 150 µg/m³). Heavy metalexceedances were significant: lead at 91 µg/m³ (PEL: 50 µg/m³), arsenicat 86 µg/m³ (PEL: 10 µg/m³), and chromium at 81 µg/m³ (PEL: 50 µg/m³). Silica reached 84.7 µg/m³ (PEL: 50 µg/m³).Conclusion: The study highlights critical occupational health risksfrom airborne chemical exposure in Bhutanese industries. Thesewidespread PEL exceedances threaten worker health and impedenational development. Urgent policy interventions are needed,including immediate action plans, strengthened regulations, robustOHS monitoring, capacity building, promoting engineering controls,and multi-stakeholder collaboration to safeguard Bhutan's workforceand ensure sustainable economic growth.

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Yang, X.

Multi-Objective Optimisation of Ventilation Strategies in Bank Buildings for Pandemic-Resilient and Energy-Efficient Operation.

SSRN, (2026)

In light of the recent COVID-19 pandemic, indoor environmental design has taken a new approach, focusing on finding efficient ways to reduce airborne transmission without sacrificing comfort or health. This study aims to develop an optimal ventilation strategy for a bank building that integrates electrochromic glass, natural ventilation, and mechanical ventilation. The influence of different operational scenarios on HVAC energy consumption and infection risk was assessed through simulations under extreme climatic conditions. In compliance with worldwide ventilation regulations, ventilation flow rates ranging from 0.25 to 0.45 m³/s were investigated. According to the results, raising ventilation rates significantly reduces the likelihood of infection, especially at lower passenger densities; however, energy consumption exceeds what is considered optimal. Even during the warmest week of the year, natural ventilation helped lower energy consumption and the risk of infection. In addition to a 16.7 per cent drop in cooling energy consumption and a 4.5 per cent drop in infection risk, electrochromic glass increased energy efficiency by 1.51 per cent. The unique contribution of this study is the creation of an NSGA-II algorithm-based comprehensive multi-objective optimisation framework that simultaneously accounts for occupant density, energy consumption, and infection risk. To determine how effective electrochromic glass is in making buildings more resistant to pandemics, we used a co-simulation method that combined EnergyPlus with MATLAB to analyses system performance. The findings offer useful recommendations for creating safe, energy-efficient interior spaces that can withstand both influenza and non-pandemic scenarios.

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Malesińska, A., Kubrak, M., Skoczko, I.

Nawilżanie powietrza w szpitalach–jakość wody jako klucz do jakości powietrza (Humidification de l'air dans les hôpitaux : la qualité de l'eau, gage de la qualité de l'air).

Ciepłownictwo, Ogrzewnictwo, Wentylacja, Vol. **57** n°(3), (2026)

Air humidification in healthcare facilities constitutes an important component of HVAC systems, affecting both occupant comfort and the microbiological safety of the indoor environment. In design and operational practice, this issue is most often analysed from the perspective of air parameters (relative humidity, temperature), while the quality of the water supplying humidification systems is less frequently considered. However, in systems generating water aerosols, the physicochemical and microbiological composition of the water may directly influence indoor air quality in hospital spaces. This article discusses the significance of relative humidity in the hospital environment, provides an overview of humidifica tion technologies, and describes the mechanisms by which waterborne contaminants can be transferred into the air. Quality requirements for water supplying steam and adiabatic systems are defined, and the design and operational consequences of inadequate water treatment are identified. It is demonstrated that water quality should be regarded as a critical element of sanitary safety in HVAC installations within healthcare facilities.

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