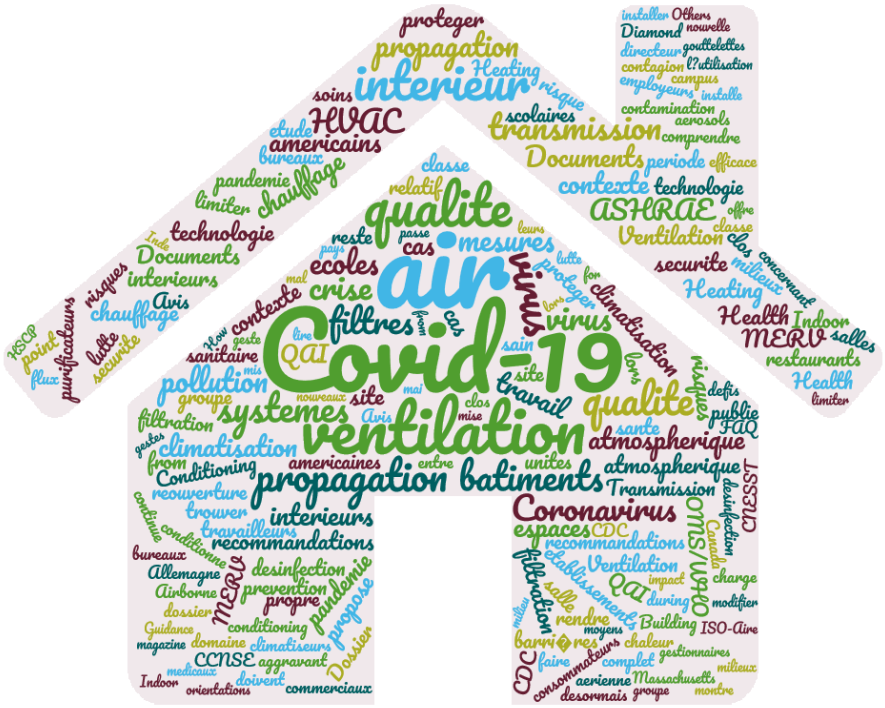

Bulletin de veille AéroCovid
N°109 - date12/02/2025

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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Fortner, K.

Analysis of Indoor Airborne Infectious Disease Transmission Risk Based on Current Design Standards.

The Pennsylvania State University. Thèse 2024

The goals of this research were to investigate the evolution of IAQ standards, develop a model to estimate the baseline long-range transmission risk of indoor infectious diseases posed by existing standards, and to evaluate the relative benefits of emerging standards such as ASHRAE 241. The estimated equivalent clean airflow per person for occupancies covered by ASHRAE 62.1 ranged from 7 to 107 cfm per person, with an average of 30 cfm per person. The equivalent clean airflow range for ASHRAE 62.2, the residential occupancy standard, was 11 to 79 cfm per person for a representative sample of hypothetical dwelling units. For ASHRAE 170, the healthcare ventilation standard, the average equivalent clean air changes per hour was 6.1, ranging from 1 to 19.5 hr-1 . Ranges provided are due primarily due to variation of space type, but are influenced by a multitude of other factors to include HVAC system type, filter efficiency, climate zone, etc. Once equivalent clean airflow rates were estimated for all spaces, a subset of spaces was run through a Monte Carlo risk analysis simulation using the Wells-Riley equation to model the most likely infection probability for the most current ASHRAE ventilation design standards. Among the modeled spaces, the space with the highest median infection probability was 0.369 for a booking/waiting room in a correctional facility. The highest level of risk, as measured by median expected cases, was 48.05 for a spectator area. While these simulation results are limited by the data fidelity and assumptions used, they provide a comprehensive assessment of the level of protection existing buildings provide if they meet the minimum ventilation requirements that does not exist elsewhere in the literature. The tool developed to establish baseline risk of existing standards has potential for additional applications that require modeling the risk of infectious aerosol as part of a larger problem set, such as pairing with an energy or economic model to evaluate the energy or cost effectiveness of different engineering controls.

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Omerzo, B., Zakula, T., Glicksman, L. R.

Experimental and CFD study of air distribution system and airflow rate impact on airborne transmission.

Building and Environment, Vol. **271**, (2025)

Ventilation in buildings is crucial for reducing the risk of airborne transmission and maintaining indoor air quality. However, determining the optimal air distribution system and airflow rate to protect against airborne transmission – particularly across different occupancy patterns – remains challenging. Although the literature is abundant with numerical studies, many overlook proper experimental validation, leading to conflicting conclusions and hindering practical implementation. To address this gap, Computational Fluid Dynamics (CFD) was used to evaluate three air distribution systems: mixing, displacement from the walls, and displacement from the floor. These evaluations were conducted at various airflow rates in office and classroom settings, focusing on defining optimal ventilation strategies and practical guidelines. The CFD model was robustly validated using experimental methods that are cost-effective yet accurate and are systematically detailed to provide a framework for others to replicate and build upon. Additionally, all measurement data are openly shared, providing a highly valuable dataset for researchers in this field to use for CFD validation. This addresses a significant gap in literature, where such resources are scarce. Our findings indicate that displacement ventilation from the floor results in the lowest infection risk at the

breathing zone, with reductions of 12 % compared to displacement from the walls and 21 % compared to mixing ventilation. However, both displacement types showed greater variability in infection probability, highlighting the advantages of mixing ventilation in spaces with unpredictable occupancy patterns. Ultimately, results of this study offer actionable insights for enhancing indoor safety and establish a solid foundation for future research.

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Han, X., Mahyuddin, N., Qin, M., Wang, P., Zhang, C., Wei, Y.*, et al.*

Effect of Different Mechanical Fans on Virus Particle Transport: A Review.

Buildings, Vol. **15** n°(3), (2025)

In recent years, repeated outbreaks of airborne viruses have normalized human coexistence with these viruses. The complex turbulence and vortices generated by different fan types and operation modes affect virus removal effectiveness. This paper reviews the potential impact and actual effectiveness of different fans in mitigating indoor virus transmission, highlighting their advantages and limitations. Downward rotating ceiling fans can rapidly dilute virus concentration (21–87%) in the breathing zone due to jet cores, with efficiency depending on rotational speed and particle diameter. However, the reprocessing problems of large particles being deposited on surfaces, and small particles settling and rebounding into the air remain unresolved. Upward-rotating ceiling fans do not contribute to indoor virus removal. Exhaust fans generate a negative-pressure environment, which helps expel viruses quickly. But improper vortex zones can increase virus retention time 16–40 times. Air-apply fans effectively dilute and transport viruses only when delivering airflow exceeding 0.5 m/s directly into the breathing zone. Additionally, combined fan strategies remain underexplored, despite potential benefits. This review underscores the need for standardized definitions of particle removal effectiveness and calls for further research on how climatic conditions and thermal comfort influence fan-based interventions.

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Soleimani-Alyar, S., Yarahmadi, R., Borhani-Jebeli, M., Yarahmadi, G., Bokharaei-Salim, F., Alipour, A.*, et al.*

The pathogenic burden potential of airborne particles in emanating from the respiratory area of COVID-19 patients (a case study).

Journal of Occupational and Environmental Hygiene, (2025), 1-13 p.

The pathogenic potential of airborne particles carrying the SARS-CoV-2 viral genome was examined by considering the size distribution of airborne particles at given distances from the respiratory zone of an infected patient after coughing or sneezing with a focus on time, temperature, and relative humidity. The results show an association between the size distribution of airborne particles, particularly PM1 and PM2.5, and the presence of viral genome in different stations affected by the distance from the respiratory zone and the passage of time. The correlation with time was strong with all the dependent factors except PM1. Also, the effect of time intervals on the median concentration of airborne PM in the range of PM7 and PM10 was significant. Accordingly, in the first 20min after coughing, the COVID-19 patient was more likely to be exposed to PM-carrying RNA genomes of SARS-CoV-2. The other finding was that the two distances of 0.25m to the patient's left of the respiratory zone and 1.0m above the breathing zone showed positive results for the presence of SARS-CoV-2 in all studied time intervals. The patterns of results suggested that there was a high potential for distribution of the virus in an infected patient based on position and airflow and that the severity of infection and viral load may influence the presence of viral load in droplets when coughing. Based on the results, one can conclude that ventilation plays a key role in mitigating the risk of airborne virus transmission in indoor environments, and it has been shown that reductions in particulate concentrations occur when portable air purifiers are placed near the breathing zone. The use of personal protective equipment for the patient and healthcare personnel to minimize the distribution of virus particles in the air is recommended.

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Kristiawan, A., Suhartono, S., Adhipireno, P.

The effect of airflow on HAIs risk in hospital: A review.

E3S Web Conf., Vol. **605**, (2025)

HAIs (Healthcare Associated Infections) are infections that are acquired when a person (host) receives health services that result in increased cost, extended Length Of Stay, and even death. This paper review a way to reduced the risk of airborne HAIs transmission based on a number of journals on management that regulates incoming and outgoing air to eliminate or reduce the number of infectious agents in indoor air to reduce the incidence of HAIs through indoor air management in health care. Ensuring that indoor air quality is good with sufficient ACH and low AOA, so that it is safe for patients, staff, and others who are at the health care location.

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Gorlach, J., Gazda, D., Trusz, A., Walaszczyk, J., Szczęśniak, S., Piekarska, K.

Ventilation and air conditioning systems are a source of antibiotic-resistant bacteria - A review.

Building and Environment, Vol. **271**, (2025)

This article provides a comprehensive review of the current state of knowledge on the impact of air conditioning systems on indoor microbial contamination of HVAC systems and microbial indoor air quality. The article emphasises the necessity for standardised sampling and assessment of microbial contamination. The importance of genetic testing in determining the identity of specific bacterial and fungal species is emphasised, as it facilitates a more precise evaluation of the microbiological risk posed. The article demonstrates that the presence of specific taxa of microorganisms, such as Alternaria spp. and Cladosporium spp. in ventilation systems, has allergenic and pathogenic potential. The article emphasises the necessity for regular maintenance and cleaning of air conditioning units, particularly air filters, cooling coils, drip trays, and fan chambers. The article demonstrates that effective indoor air quality management and advanced research methods are crucial to minimise health risks associated with exposure to undesirable microorganisms in rooms served by HVAC systems and AC units. This synthesis of current research provides valuable insight into the challenges and opportunities associated with managing microbial communities in indoor environments, emphasizing the importance of innovative approaches and public health policies to address microbial contamination and improve health outcomes. This article sets out the findings of research which has identified 96 bacterial and 61 fungal species. A proportion of these have been found to be endemic to HVAC systems or AC units; however, a number have also been identified to occur in both types of installation.

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Du, C.

Analyses of Static and Dynamic Airflow and Contaminant Dispersion in Elevator Environments.

Purdue University Graduate School. Thèse 2025

This study investigates airflow patterns and contaminant concentration in elevator-related areas, highlighting their critical role in indoor air quality and infection control. Despite widespread reliance on elevators, limited research addresses airflow patterns and contaminant behavior in these confined, high-density spaces. Using a full-scale elevator mockup connected to a lobby, this study conducted static and dynamic experiments to measure air velocity, temperature, and contaminant concentration. Static tests analyzed closed cabins with mixed ventilation, while dynamic tests examined the impact of passenger movement on airflow and contaminant dispersion.

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Mellon, G., Mahjoub, N., Metivier, F., Osinski, N., Gabassi, A., Delaugerre, C.*, et al.*

Enhancing the control of respiratory virus spread: a comprehensive approach integrating airborne virus detection, aerological investigations, and airflow modeling for practical implementation.

Infection Control & Hospital Epidemiology, (2025), 1-10 p.

Objective:Patients with chronic kidney disease suffer from immune dysfunction, increasing susceptibility to infections. The aim of the study was to investigate air contamination with respiratory viruses in a dialysis unit at a quaternary hospital using molecular detection techniques and to analyze airflow dynamics through computational fluid dynamics (CFD) simulations for a comprehensive assessment of air transmission risks.Methods:We conducted dialysis unit air sampling using AerosolSense™ samplers. Air and clinical sampling occurred during three periods in 2022: winter, early, and late fall. A technical team maintained the dialysis unit's ventilation system during mid fall. Ventilation system capacity and airflow rates were measured. CFD simulations were used to evaluate airflow dynamics.Results:The investigation collected 144 air samples, revealing heterogeneous virus detection rates across locations and study periods. Virus positivity correlated with the presence of patients and the effectiveness of the ventilation system. The ratio of virus air positivity to virus patient positivity was 1.84 and 3.35 during the first and the second periods, respectively, and collapsed to 0.64 after maintenance. Airflow rate measurements highlighted a ninefold discrepancy between actual and theoretical airflow (393 m3/h vs. 3530 m3/h), which was rectified by maintenance actions. Airflow dynamics and particle dispersion visualization through CFD simulations contributed to a better understanding of transmission risks.Conclusions:Detection of viruses in the air, combined with CFD, revealed deficiencies in air renewal. Maintenance interventions significantly improved airflow dynamics and particle dispersion, reducing airborne virus spread.

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Li, T., Katz, A., Osei-Twum, J.-A., James, L., Leung, V., Bozek, P.*, et al.*

Science tells us that portable air filters reduce infection risk. It's time for public health authorities to make this clear.

Journal of Infection and Public Health, Vol. **18** n°(3), (2025)

Throughout the COVID-19 pandemic, Canadian public health advisors and politicians have shared mixed messages about the utility of portable air filters (PAFs) for mitigating the transmission of airborne infectious diseases. Some public health advisors and decision-makers have also suggested that PAFs are cumbersome or require expert advice. We take this opportunity to review evidence and address myths about PAFs. In short, PAFs are an important tool to help reduce the risk of transmission of airborne infectious diseases. Moreover, PAFs are relatively simple to use, and there is a variety of high-quality guidance available for their deployment. We share this science here with the expectation that, going forward, public health authorities will position PAFs appropriately in infection prevention and control plans for both health care and community settings.

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

Comparison of non-infectious air delivery rate and energy consumption-Room air cleaners versus in-duct ultraviolet light inactivation of airborne pathogens.

International Conference on Indoor Air Quality and Climate: Sustaining the Indoor Air Revolution: Raise Your Impact - Honolulu, United States. 7 Jul 2024 → 11 Jul 2024

To reduce the risk of airborne infections, it is necessary to increase the air flow rates that are free of viable pathogens. This can be achieved by using devices such as portable clean air cleaners or in-duct UV germicidal irradiation devices. In this study, we compare the energy consumption of these devices to produce non-infectious air flow rates. We define the specific power as the ratio of electrical power to non-infectious air flow rate. We measured the clean air delivery rate and the power consumption of ten different room air cleaners. We also obtained the electric power consumption and the airborne bio-aerosol inactivation efficiencies of nine induct ultraviolet light devices from a previous study. The results show that

there are large variations in the specific power of both types of devices. Our method allows us to compare different alternatives and find sustainable solutions for airborne infection mitigation.

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Tang, H., Su, Y., Liu, X., Li, C., Yuan, L.

Risk assessment of exhaled infectious aerosols transmission driven by natural ventilation in four nursing homes.

Building Simulation, (2025)

The severity and mortality rates associated with respiratory infectious diseases are notably elevated among older adults compared to younger populations. Nursing homes, which accommodate a considerable number of elderly individuals, are particularly vulnerable to disease outbreaks. This study proposes a method to assess the spatial infection risk of airborne transmission of respiratory diseases by coupling building layout and infiltrations. Field investigations were conducted to summarize nursing homes layout plan and occupants' activity characteristics. Meteorological parameters were used to obtain the wind pressure on building surfaces through computational fluid dynamics. The building ventilation network was further developed to quantify the pathogen exposure and infection risk of occupants. Results indicated that high infectious aerosol exposure appeared in the rooms with more occupants and low ventilation rates. In nursing homes, activity rooms were the highest infectious aerosol exposure area, accounting for 38.5%–47.9% of total exposure in a standard floor, followed by bedrooms, dining halls, and offices. Self-transmission dominated pathogen aerosol transmission, with self-transmission rates exceeding 70% in most rooms. Enhancing natural ventilation was validated as effective to reduce the risk of infection from infectious aerosol exposure. The proposed infection risk assessment is beneficial for the nursing home design in order to reduce the airborne transmission of respiratory diseases.

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Chen, J.-K., Su, T.-C., Chen, C.-Y.

Ventilation is a Lesson from COVID-19 Pandemic.

台灣醫學, Vol. **29** n°(1), (2025), 55-61 p.

The unexpected COVID-19 pandemic has led the world to reconsider the importance of disease prevention, especially highlighting the roles of public health and environmental control. We believe that effective disease prevention cannot depend solely on medication but requires building healthy environments and habits. Airflow is crucial in preventing airborne transmission of pathogens. We propose three core concepts for ventilation: intake and exhaust, resistance determines the path, and clean to less clean. These concepts aim to create directional airflow, ensuring pollutants are directed downstream and reducing transmission risks. Effective ventilation requires attention to space design, layout, and airflow paths to prevent aerosol buildup in enclosed spaces. In the home, good ventilation reduces obstructions and can be supported by devices like CO_2 sensors to monitor air quality. In summary, COVID-19 has reminded us of the importance of ventilation for health, maintaining good air quality, and enhancing infection control and residential safety.

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Pyrć, K.

In Pursuit of New Viruses.

ACADEMIA. The magazine of the Polish Academy of Sciences, Vol. n°(No 4(84) Health), (2024), 48-53 p.

Prof. Krzysztof Pyrć, head of the BSL3+ Virology Laboratory at the Małopolska Centre of Biotechnology, Jagiellonian University (MCB UJ), and a member of the Climate Crisis Committee of the Polish Academy of Sciences, talks about his work as a virologist and the challenges posed by climate change.

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Nateghi, S., Kaczmarczyk, J., Zabłocka-Godlewska, E., Przystaś, W.

Investigating the impact of physical barriers on air change effectiveness and aerosol transmission under mixing air distribution.

Building and Environment, Vol. **272**, (2025)

This research investigated the effectiveness of desk partitions in reducing airborne infection risks in classroom environments. Experiments were conducted in a controlled test chamber with two designs of mixing air distribution systems (MV1 and MV2). Nebulized aerosols and bioaerosols were utilized in the presence of physical barriers to simulate the transmission of exhaled droplets from a source of infection and to assess this transmission among individuals sitting near this source. In addition, local air change effectiveness (ACE) was evaluated based on age of air measurements using CO2 tracer gas decay method. Results showed that air change effectiveness without partitions were higher than with partitions for both systems, indicating that partitions create an obstacle for effective ventilation air distribution. Moreover, MV1 exhibited significant ACE reductions at some points with partitions, while MV2 maintained high ACE values across all points. For aerosol measurements, MV2 achieved high concentration reduction rates (CR) around 0.8 across all points, whereas MV1 exhibited mixed results, with some points showing negative CR values due to airflow obstruction. For bioaerosol generation bacteria Micrococcus luteus was used. Sampling of bioaerosol measured Micrococcus luteus concentrations, 4- and 45-minutes post-generation. MV2 system was more effective in reducing bacterial concentrations with partitions, while MV1 showed variable results, with partitions reducing concentrations at some points but increasing them at others. Overall, MV2 demonstrated superior performance in maintaining lower contaminant concentrations, especially for environments requiring prevention measures or where maintaining well-mixed air is difficult.

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Daneshazarian, R., Nahian, M. R., Siegel, J.

An experimental study of respiratory particle dispersion in an operating room under positive and negative pressurization.

Journal of Building Engineering, Vol. **102**, (2025)

Hospital operating rooms (ORs) are typically maintained at positive pressure, which can increase the risk of disease transmission to healthcare workers and to spaces outside of the OR when an infected patient is present. This study investigates the influence of operating room pressurization (positive and negative) and dynamic healthcare worker (HCW) activity on respiratory particle dispersion, addressing gaps in understanding airflow dynamics and infection control. Experiments were conducted in a full-scale OR to simulate conditions with a continuous respiratory aerosol source and a cough source, analyzing particle concentration under varying pressurization scenarios and with anteroom interactions. Key findings reveal that negative pressurization effectively reduces respiratory particle concentrations across the OR, with a ventilation efficiency of 78 % compared to 59 % under positive pressurization. The use of an anteroom reduced particle concentrations by 25 % at the operating table and up to 31 % in the anteroom. Movement of healthcare workers significantly influenced aerosol dispersion, with particle concentrations increasing by 17.8 % at higher speeds (1.2 m/s) under positive pressure. Faster HCW movement increases particle spread, particularly under positive pressure. The inclusion of an anteroom further reduces particle migration to adjacent areas, emphasizing its importance in infection control strategies. The study's results highlight the effectiveness of negative pressure systems in mitigating airborne infectious disease transmission and demonstrate the value of anterooms in enhancing containment. These findings contribute to optimizing OR design and ventilation practices, providing evidence-based recommendations for safer healthcare environments, and delivers insights to inform future standards in building engineering for infection control.

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Cole, M.

Mitigating COVID-19 Transmission in Long-term Care: A Facility's Experience with Dry Hydrogen Peroxide.

American Journal of Infection Control, (2025)

A staff-initiated outbreak of COVID-19 among residents in a long-term care facility was notable for differences in attack rates between units and the association with dry hydrogen peroxide deployment for continuous microbial reduction. Dry hydrogen peroxide had previously been shown to significantly reduce environmental bioburden in the facility, but the association with infection had not been monitored. This outbreak highlights the potential for dry hydrogen peroxide to reduce infection transmission without requiring additional staff intervention.

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Abene, S.

Enhancing Air Quality and Controlling Infections on Cruise Ships.

Web page ContagionLive 2025

Prashant Kumar's study on indoor air quality aboard cruise ships highlights the critical role of ventilation and masking in reducing infection risks.

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Omerzo, B., Zakula, T.

Ventilation Strategies Against Airborne Transmission.

19th Conference on Sustainable Development of Energy, Water and Environment Systems. Roma, Italia, 08.09.2024-12.09.2024

This study presents a numerical analysis of the three most commonly used ventilation systems (mixing, displacement from the floor, and displacement from the walls) in an office environment to assess their efficacy in preventing airborne transmission. The analysis included four human models, one representing an infected individual. Carbon monoxide was used as a proxy to simulate exhaled aerosols – a method widely used in the literature.

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Tugores, J., Macarulla, M., Gangolells, M.

Assessment of airborne infection risk in naturally ventilated environments.

Journal of Building Engineering, Vol. **100**, (2025)

During the COVID-19 pandemic, natural ventilation emerged as a widely recommended strategy to improve indoor air quality and reduce airborne infection risks. However, due to the inert uncertainty, accurately determining natural ventilation rates to assess the true impact of this practice proved challenging for building managers. Traditionally, the Wells-Riley approach has been used for airborne infection probability risk assessment when steady-state conditions are assumed. However, when this method is applied to naturally ventilated facilities, it may yield inaccuracies because of irregular ventilation rates caused by the occupants' window opening patterns. The paper introduces a novel methodology for evaluating airborne infection probability in naturally ventilated environments. Firstly, natural ventilation rates are estimated using a grey box model of indoor CO2 concentration. This approach was validated using in-situ data from a case study in different periods (spring, summer and winter). Then, the infection probability risk was calculated by discretizing the accumulative virus portion inhaled by the occupants at each time. The results prove the grey box model's effectiveness in estimating natural ventilation rates in educational facilities. Concerning the evaluation of infection probability risk, the proposed approach aligns with observations in previous research that link lower ventilation rates with higher infection risk. However, the methodology provides a better representation of real-world variability than the Wells-Riley approach and enables the

identification of vulnerable periods. The integration of this methodology into natural ventilation system management could optimize window-opening strategies to mitigate airborne transmission diseases in educational facilities, considering diverse infective incidence rates and pathogens.

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Musa, M. U., Biwole, P. H., Labbe, A.

Multiple 3D particle tracking velocimetry for measuring airflow and pathogen trajectory in large indoor spaces.

Building and Environment, Vol. **271**, (2025)

Indoor air quality and the transmission of respiratory infections are critical public health concerns exacerbated by our limited understanding of how pathogens disperse in indoor environments. Predicting exhaled airflow and indoor airflow in buildings is a complex task due to the turbulent, three-dimensional, and large-scale nature of such flows. This study introduces a novel multiple 3D particle tracking velocimetry (multi-3DPTV) method for measuring particle dispersion trajectories in large indoor spaces. The method relies on connecting several multi-camera 3DPTV systems positioned side by side. First, the hardware and tracking algorithms of the multi-3DPTV system are discussed. Then, a numerical validation is conducted by using computer-generated particle motion data of a linear flow, and the analytical Navier-Stokes solutions of incompressible 2D Kovasznay and 3D Beltrami flows. Last, the method is experimentally validated on a setup mimicking an unobstructed cough jet. The numerical results suggest that the performance of multi-3DPTV depends on the accuracy of each 3DPTV system and particle motion type. The experiments successfully linked the trajectory of exhaled airborne cough particles, revealing particles traveling up to 3.5 m from the source. The multi-3DPTV approach is a promising solution to overcome the limitations of current global-wise measurement techniques in characterizing indoor air and exhaled air dynamics. Potential applications include developing more effective ventilation systems and disease control strategies in indoor environments.

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Shoemaker, H., Li, H., Zhang, Y., Mayer, J., Rubin, M., Haroldsen, C.*, et al.*

Association between social activities and risk of COVID-19 in a cohort of healthcare personnel.

Antimicrobial Stewardship & Healthcare Epidemiology, Vol. **5** n°(1), (2025)

Objective:Previous studies have linked social behaviors to COVID-19 risk in the general population. The impact of these behaviors among healthcare personnel, who face higher workplace exposure risks and possess greater prevention awareness, remains less explored.Design:We conducted a Prospective cohort study from December 2021 to May 2022, using monthly surveys. Exposures included (1) a composite of nine common social activities in the past month and (2) similarity of social behavior compared to pre-pandemic. Outcomes included self-reported SARS-CoV-2 infection (primary)and testing for SARS-CoV-2 (secondary). Mixed-effect logistic regression assessed the association between social behavior and outcomes, adjusting for baseline and time-dependent covariates. To account for missed surveys, we employed inverse probability-of-censoring weighting with a propensity score approach.Setting:An academic healthcare system.Participants:Healthcare personnel.Results:Of 1,302 healthcare personnel who completed ≥2 surveys, 244 reported ≥1 positive test during the study, resulting in a cumulative incidence of 19%. More social activities in the past month and social behavior similar to pre-pandemic levels were associated with increased likelihood of SARS-CoV-2 infection (recent social activity composite: OR = 1.11, 95% CI 1.02–1.21; pre-pandemic social similarity: OR = 1.14, 95% CI 1.07–1.21). Neither was significantly associated with testing for SARS-CoV-2.Conclusions:Healthcare personnel social behavior outside work was associated with a higher risk for COVID-19. To protect the hospital workforce, risk mitigation strategies for healthcare personnel should focus on both the community and workplace.

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Jiaxin, Z., Sumei, L., Junjie, L.

Study on the effect of targeted ventilation purification technology on pathogen aerosol removal in ward.

The 5th Asia Conference of International Building. Performance Simulation Association 2024. Osaka, Japan. December 8-10, 2024

Negative pressure isolation wards (NPIWs) can provide treatment for COVID-19 patients during a pandemic. However, breathing releases aerosols containing pathogens, resulting in a potential infection risk for health care workers (HCWs). Robust ventilation in NPIWs can potentially reduce the infection risk, but can also increase energy consumption. Therefore, it is important to decrease energy consumption in NPIWs. This study proposes TARGETING, a new index for assessing the targeting of ventilation systems. The air curtain ventilation (ACV) achieved better comprehensive benefits, with an TARGETING of 1.3 and energy saving is about 35.9-58.0%.

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Rada, E. C., Vignali, C., Bellazzi, S., Carnevale Miino, M., Abbà, A., Szabó, M.*, et al.*

Disinfection of indoor air for the inactivation of SARS-CoV-2: a review of the effectiveness of UV-C technology and gaps in research.

Frontiers in Built Environment, Vol. **10**, (2025)

This work aims to review and discuss these findings while also presenting recommendations for future research. Based on the available data, UV-C proved to be effective in the inactivation of airborne SARS-CoV-2 or its surrogates. The main gaps in this research have also been highlighted, and some outlooks for future studies have been suggested.

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Armand, P., Tâche, J.

3D modelling and simulation of thermal effects and dispersion of particles carrying infectious respiratory agents in a railway transport coach.

Scientific Reports, Vol. **15** n°(1), (2025)

Even though the COVID-19 pandemic now belongs to the long history of infectious diseases that have struck humanity, pathogenic biological agents continue to pose a recurring threat in private places, but also and mainly in places where the public congregates. In our recent research published in this journal in 2022 and 2023, we considered the illustrative example of a commuter train coach in which a symptomatic or asymptomatic passenger, assumed to be infected with a respiratory disease, sits among other travellers. The passenger emits liquid particles containing, for example, COVID-19 virions or any other pathogen. The size spectrum of particles varies depending on whether they are produced during breathing, speaking, coughing or sneezing. More specifically, droplets associated with breathing are in the range of 1–10 µm in aerodynamic diameter, while at the other end of the spectrum, drops associated with coughing can reach 100–1000 µm. In the first part of our research, we used Computational Fluid Dynamics (CFD) to model and simulate in 3D the transport and dispersion of particles from 1 µm to 1 mm in the turbulent flow generated by the ventilation of the railway coach. We used both the Eulerian approach and the Lagrangian approach and showed that the results were strictly similar and illustrated the very distinct aerodynamics, on one hand, of the aerosol of droplets suspended in the air and, on the other hand, of the drops falling or behaving like projectiles depending on their initial speed. In the second part of our research, we developed a model of filtration through a typical surgical mask and possible leaks around the mask if it is poorly adjusted. We resumed the twin experiment of the railway coach and compared the distribution of droplets depending on whether the passengers (including the infected one) wear masks or not and whether the masks are perfectly fitted or worn loosely. Our method made it possible to quantify the particles suspended in the air of the railway coach depending on whether the infected passenger wore their mask more or less well. In this third article, we specifically explore how thermal effects due to the presence of passengers influence the spatio-temporal distribution in the railway coach of aerosols produced by the breathing

infected person. We demonstrate that the influence of thermal effects on aerodynamics is very significant and can be very favourable for air decontamination if the ventilation system is judiciously configured. Beyond its application to a commuter train, our work confirms the value of validated CFD tools for describing the airflow and dispersion of particles in complex spaces that do not always allow experimentation. The models that we have developed are applicable to any other semi-confined, ventilated public place, such as a classroom, a hospital room or a performance hall, and they enable the objective assessment of whether the occupation of these spaces could be critical with regard to infectious contamination and of how to limit this ubiquitous risk.

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Baldasso, C. N., Teichert-Filho, R., Marinowic, D. R., Campos, M. M., Gomes, M. S.

Microbiological and Ergonomic Effects of Three Prototypes of a Device to Reduce Aerosol Dispersion in Dental Care During the COVID-19 Pandemic: A Randomized Controlled Clinical Trial.

Dentistry Journal, Vol. **13** n°(2), (2025)

Objectives: This randomized clinical trial evaluated the microbiological efficacy and the ergonomic impact of three prototypes of a device to reduce aerosol dispersion during dental procedures. Methods: Sixty patients undergoing dental care using high-speed turbines and/or ultrasonic tips were randomly assigned to 4 groups (n = 15): CG: control group, with standard personal protective equipment (PPE); G1: PPE + acrylic device (AD) with aspiration; G2: PPE + AD without aspiration; and G3: PPE + polyvinyl chloride device. The device prototypes consisted of a rigid translucent acrylic structure (G1 and G2), or a rigid PVC tube structure surrounded by layers of translucent flexible PVC films (G3), adjusted to the dental chair, involving the patient's head, neck and chest. The main outcome was the microbiological analysis (mean Δ of CFU at 10 different sites), and the secondary outcome was the ergonomic evaluation (questionnaire to dentists and patients). Results: The final sample comprised 59 participants (mean age 38.6 ± 11.4 years, 55.2% male). The overall mean time for dental procedures was 32.4 ± 16.9 min, with no differences between groups (p = 0.348). Microbiological analyses showed that the use of the device significantly reduced contamination in the light reflector (01.46 ± 4.43 ΔCFU in G2 vs. 19.25 ± 36.50 ΔCFU in CG; p = 0.028), apron (09.11 ± 12.05 ΔCFU in G3 vs. 21.14 ± 43.41 ΔCFU in GC; p = 0.044), and face shield (08.80 ± 32.70 ΔCFU in G1 vs. 56.78 ± 76.64 ΔCFU in the GC; p = 0.017). The device was well accepted by patients and increased the dentists' perception of safety and protection (p < 0.001), but significantly decreased ergonomics related to the clinical view, space, agility and access to the patient, and ease of performing procedures (p < 0.001). Conclusions: The tested device can be an additional tool for infection prevention and control in dentistry, not only during the COVID-19 pandemic, but also for the control of future infectious diseases and epidemics.

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Impinging jet ventilation: Mitigating influenza transmission through partition and exhaust layout optimization.

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This paper investigates the transmission characteristics of cough droplets from infected individuals in office environments under the influence of an impinging jet ventilation (IJV) system based on the Eulerian–Lagrangian model. The accuracy of the dispersed phase model and the IJV system simulation was validated by analyzing a single droplet evaporation model, publicly available jet experimental results, and previously simulated results. The effects of different exhaust locations, the relative positioning of the IJV system to the infected individual, and the application of partitions on the spatial propagation characteristics of droplets are explored. The results indicate that partitions exhibit a significant ability to obstruct and capture droplets. Under static conditions, they are capable of capturing over 36% of droplets generated by coughing, although this efficiency may be slightly influenced by the ventilation system. The IJV system notably affects droplet movement, with droplets progressively converging toward the upper-left corner of

the room as the airflow develops. The positioning of the exhausts, in combination with the IJV system, is crucial in impeding and removing droplets. Taking into account variations in the infected individual's position, a centrally located exhaust arrangement might provide the more effective inhibition of virus droplet dispersion.

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