Bulletin de veille AéroCovid
N°107 – 15/01/2025

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

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Shang, N., Herve, R., Kim, M., Lawson, J., Ganapathisubramani, B., Keevil, C.

Air Sterilisation and Treatment by Non-Thermal Atmospheric Plasma.

Plasma Medicine, (2024)

Air purification is critical to mitigating the challenges of airborne pathogen transmission and protecting the public health since covid-19 pandemic. In this work, a novel porous alumina dielectric barrier discharge (DBD) source integrated plasma air sterilisation and treatment apparatus is fabricated to sterilize airborne pathogens under various discharge conditions, two air flow rates and treatment times. Results show that the DBD plasma apparatus has a dual function of physical filtration and plasma sterilisation to airborne pathogens. The plasma inactivation level depends on the discharge voltage, air flow rate and treatment time, and reaches a maximum reduction of 2.5 Log when a full glowing plasma source is used for 45 min. Study of optical emission spectra and ozone concentration measurements reveals that the plasma generated ozone species and UV irradiation may play a critical role in the air sterilisation.,

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Duill, F. F., Schulz, F., Jain, A., Paucke, N., Van Wachem, B., Beyrau, F.

Analysis of IAQ in classrooms during COVID-19 pandemic and the effect of window ventilation and air cleaners depending on season.

Building and Environment, Vol. **270**, (2025)

The first part of this study presents CO2 measurements in classrooms without HVAC systems during the final phase of the COVID-19 pandemic. CO2 concentration is a widely used proxy for indoor air quality (IAQ) and ventilation efficiency, and serves as an indicator of the potential viral aerosol load. Measurements taken during the cold season (03/2023) and warm season (06–07/2022) reveal significant variability, with CO2 levels exceeding recommended thresholds in certain scenarios. The study identifies specific factors contributing to elevated CO2 concentrations, which are generally associated with an increased presence of exhaled particles in the air. The second part of the study evaluates strategies to reduce particle number concentration (PNC) in classrooms, including different window ventilation approaches, the use of a large air cleaner (AP) with varying flow rates, and their combination. The effectiveness of these interventions in mitigating PNC is assessed through the introduction of DEHS particles and subsequent PNC measurements using aerosol spectrometers. The observed decay rates of PNC under various ventilation conditions demonstrate that combining AP usage with window ventilation leads to further reductions in particle concentration, irrespective of seasonal variations. The interaction between the AP and window ventilation is found to be influenced by external conditions and ventilation type, rather than by variations in the ventilation area. Furthermore, the study discusses the potential inhalation of virus-laden particles during a simulated 90 min school lesson, comparing exposure levels across different ventilation scenarios.

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Tanihata, Y., Takebayashi, K., Kitagawa, H., Iguchi, M., Iinuma, Y., Sakamoto, T.*, et al.*

Analysis of Infectious Diseases in Himi City, Japan, During the Noto Earthquake in 2024 Amid the Ongoing COVID-19 Pandemic.

Cureus, Vol. **16** n°(12), (2024)

Introduction: Earthquakes are among the most striking natural phenomena, with a very high potential to set off a chain of events, including casualties and injuries, substantially impacting public health. In particular,

earthquakes can trigger outbreaks and epidemics of infectious diseases during the post-earthquake period. Accordingly, we analyzed infectious diseases in Himi City during the Noto earthquake in January 2024, a period during which COVID-19 infections were also prevalent.

Materials and methods: A cross-sectional study was conducted from January 1, 2024, to January 14, 2024, to obtain precise, timely data on public health and estimate the short-term occurrence of infectious diseases among disaster victims after the Noto earthquake. We studied the medical records of all patients who visited the emergency department of Kanazawa Medical University Himi Municipal Hospital, located near the Noto earthquake. Of the 411 participants evaluated, 218 patients (53%) were males and 193 (47%) were females. Of the 411 people, 275 (67%) had an infectious disease. We investigated specific COVID-19 infection locations where individuals may have been infected, including primary evacuation centers, and examined the number of cases on each day of consultation.

Results: Infections at evacuation centers peaked on January 4 and 5, 2024. Infections at primary evacuation centers occurred on January 9, 2024.

Conclusion: A combined pandemic and earthquake disaster may worsen disease severity. To control the risk factors of infectious diseases, primary shelters should improve our consideration of the effects of interventions and prepare for potential infectious disease outbreaks.,

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Erenler, A. K., Erenler, B. H., Baydin, A.

Are we ready for the next pandemic: Disease X.

Reviews and Research in Medical Microbiology, (2024)

Disease X is a term that defines a disease with a potential to cause the next pandemic. Disease X may result from various agents including viruses, bacteria, fungi, parasites, and prions. Disease X is estimated to be a zoonosis, most likely an RNA virus, which may easily be transmitted among humans. Former diseases that have similarities with Disease X were HIV, severe acute respiratory syndrome (SARS), Zika, Ebola and the most recently COVID-19. Other potential agents that may cause Disease X are Ebola and Marburg virus, Crimean–Congo hemorrhagic fever, Lassa fever, Middle East respiratory syndrome (MERS), Rift valley fever, Zika fever, Nipah and Henipaviral diseases. As the number of activities in the wildlife and consumption of uncontrolled animal source foods increases, it is inevitable to experience pandemics in the future. In addition, climate change is another reason for emergence of novel viruses. Possible pathogens in exotic animals and animal products should be controlled and sampled. Measures such as scientific collaboration between clinicians and public health officials, avoidance of disinformation, travel limitations and screening of the passengers with technological devices, an active surveillance system involving widespread testing, social distancing and quarantine should be maintained.,

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Xia, M.

Bioaerosol Sampling for Viral Detection in Public Spaces: Application of Bioaerosol Sampling Devices in Long-Term Monitoring of Airborne Pathogens in a Railway Station and a Subway Station.

Harvard University. Thèse 2024

This thesis investigates the effectiveness of the BC500 impact-based bioaerosol sampling device for detecting airborne viruses in both laboratory and real-world environments. By optimizing sampling and post-processing conditions, the BC500 demonstrated an impressive detection limit as low as 0.35 copy/L for airborne viruses during laboratory evaluation. In field applications at high-traffic public spaces, such as Beijing Railway Station and Xidan Subway Station, the device successfully detected SARS-CoV-2, Influenza A, and Influenza B. Specifically, SARS-CoV-2 was found in 52.9% of samples at Beijing Railway Station and 44.4% at Xidan Subway Station. Influenza A was detected in 47.1% of samples from the railway station and 18.5% from the subway station, while Influenza B appeared in 23.5% and 7.4% of the

samples respectively. These findings underscore the widespread presence of airborne viruses in crowded environments, demonstrating the value of BC500, a non-intrusive and highly sensitive tool for public health surveillance. The significant detection rates of multiple pathogens in this study highlight the need for enhanced public health measures, including regular bioaerosol monitoring and improved ventilation, to mitigate airborne transmission in densely populated areas. Furthermore, integrating bioaerosol sampling into existing surveillance frameworks could enable early outbreak detection, supporting timely responses to emerging health threats. This research contributes to the standardization of bioaerosol sampling practices and underscores its vital role in strengthening public health monitoring and response efforts.

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Lee, Y., Choi, M. H., Song, Y.-S., Lee, J.-G., Park, J. Y., Li, K.-J.

Building an Indoor Digital Twin—A Use-Case for a Hospital Digital Twin to Analyze COVID-19 Transmission.

ISPRS International Journal of Geo-Information, Vol. **13** n°(12), (2024)

As indoor space becomes more important in our daily life, the demand to build digital twins for indoor spaces is increasing accordingly. The properties of indoor spaces, however, differ from those of outdoor spaces, and we need to apply different approaches to build indoor digital twins. In our work, we propose a framework for building an indoor digital twin with a use case for hospitals in general and large hospitals in particular, which may be considered as one of the most complicated types of digital twin. One of our goals is to establish a framework for building indoor digital twins based on standards and our framework starts from OGC IndoorGML, which is a standard for indoor data models and encoding schemes for indoor spatial data. In this paper, each step of the framework is presented for the construction of an indoor hospital digital twin focusing on a use case of epidemic analysis of COVID-19 transmission in a hospital. The use case study covers the entire life cycle of the indoor spatial application from requirement analysis, data modeling, and building indoor spatial data to the development of a COVID-19 transmission analysis. Our work represents a use case for indoor digital twins based on the OGC IndoorGML standard and eventually may serve as a framework and reference for building indoor digital twins. As our work is mainly focused on the construction of hospital digital twins, the study on COVID-19 infection model itself is limited in this paper. Improvement of the infection models and validations will be the next step of our work. As HVAC (heat, ventilation, and air conditioning) was not fully considered in our use case, we also expect that it is possible to strengthen our use case by including HVAC for the analysis of airflow dynamics.

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Hupkes, J., Burton, L. O., Brown, R., Li, Z., Morawska, L.

Building Ventilation and Fluid Mechanics: A Foundational Taxonomy of Australian Terminology.

In: 24th Australasian Fluid Mechanics Conference (AFMC). . Australasian Fluid Mechanics Society (AFMS); 2024. pp. 1-8.

Amid the COVID-19 pandemic, the role of ventilation in controlling infection spread and ensuring indoor air quality (IAQ) gained critical attention. The 1918-1920 Spanish flu pandemic, in its day, motivated Robert Boyle (1923) to write his foundational report The Ventilation of Public Buildings. Since that time however, inconsistent and contradictory terminology in building design standards and industry practices globally, has contributed to unnecessary complications. This paper introduces a research study which aims to harmonise ventilation terminology, based on principles of fluid mechanics. This work is key to The Australian Research Council Training Centre for Advanced Building Systems against Airborne Infection Transmission (THRIVE) mission, to engineer advanced building systems that enhance IAQ, mitigate airborne infection transmission, and maintain comfort and energy efficiency. The research categorises ventilation into natural, mechanical, and hybrid strategies. It presents a foundational taxonomy of 32 ventilation types that are commonly used in Australia, linking terminology across a variety of building codes, standards, and guidelines, different disciplines such as architecture and engineering, and academic literature. Of these 32 types, one has been found in academic literature only, and the remaining 31 occur in both types of literature. Harmonising

ventilation terminology, and identifying key physical principles like buoyancy, stratification, aerosol physics, and scalar transport (e.g. CO2), provides a unified approach to advance the understanding and application of ventilation strategies, resulting in improved airborne infection control in indoor built environments.,

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Guerrero Ramírez, K., Nuevo-Gallardo, C., Santamaría Ulecia, J. M., Montalbán Pozas, B., Fernández Bandera, C.

Calibrated models for effective clustering: Discriminating operation schedules in occupied buildings.

Building Simulation, (2024)

European directives advocate for end-users to be aware of their energy consumption. However, individual energy monitoring tools, such as energy meters or cost allocators, are not always affordable or technically feasible to install. Therefore, the development of virtual tools that enable the study of energy consumption in existing buildings is necessary. Virtual sensors, particularly based on white-box models, offer the opportunity to recreate these behaviours. When calibrated with measured data, white-box models, which incorporate detailed building physics, become increasingly valuable for designing energy-efficient buildings. This research explores a novel approach to identifying building's load period directly from energy data generated by these calibrated models. The volume of data generated by white-box models can be overwhelming for visual analysis, but the hypothesis here is that analysing this data through clustering techniques can reveal patterns related to occupant behaviour and operational schedules. By feeding indoor temperature data into the calibrated model and analysing the resulting energy outputs, the research proposes a method to identify the heating, ventilation and air conditioning (HVAC) system operation schedule, free oscillation periods and non-recurrent events. Validation is achieved by comparing the identified periods with actual measured data. This methodology enables the development of a virtual sensor for cost allocation, which minimises the need for physical sensor deployment while complying with European Union directives. The research not only demonstrates high accuracy but also the potential to outperform measured schedule. This suggests the ability of the method to identify missing sensor data or other factors affecting temperature curves, enabling fault detection and diagnostics (FDD). Consequently, this opens doors for setting optimised operation schedules that balance energy efficiency with occupant comfort.

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Jacob Jeslu, C., Pandit, D., Sen, J.

Case Study Exploring the Influence of Diffuser Arrangement on Air Distribution Using Field Experiments and Computational Fluid Dynamics Simulations.

Journal of Architectural Engineering, Vol. **31** n°(1), (2025)

Air distribution design plays a critical role in reducing HVAC energy consumption. Previous studies have suggested that placing supply and return diffusers very close to each other in overhead air-conditioning systems can lead to the immediate loss of cool air through the return diffusers without conditioning the air of the occupied region. There is a research gap in experimentally validating the same. Therefore, we performed a case study in the conference room of an office building in India using sensor readings and computational fluid dynamics (CFD) simulations to explore how the relative distance between diffusers influenced the air distribution in a zone and to suggest methods for rearranging the diffusers to improve the air distribution. Our experimental results showed that the air temperature at the return diffusers was lower than in the occupied region, which highlights that cool air was exiting through the return vents before effectively cooling the occupied zone. A CFD model of the room was developed and validated using the experimental results. The CFD simulation results showed that the presence of ceiling lights between the supply and return diffusers can delay the escape of cool air by a few minutes, thus slightly improving the air distribution. However, installing ceiling lights between the diffusers cannot be used as a strategy to reduce the loss of cool air through the return diffusers. Placing the diffusers at distances beyond the extent of the

dispersion of the air jets from the supply inlets was found to improve the air distribution, and this strategy can be used to reduce the immediate escape of cool air through the return diffusers.

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Wei, Z., Bovornkitti, S., Soontornchai, S., You, J.

Construction of effective nosocomial infection prevention and control measures in designated hospitals for covid-19-taking the temporary emergency hospital of boise city as an example.

17th International Conference in Osaka, Japan

Based on the practice of nosocomial infection prevention and control of the novel coronavirus pneumonia epidemic in Baise Temporary Emergency Hospital, the prevention and control practices of nosocomial infection prevention and control in designated hospitals are explored and formulated according to the prevention and control policies of Chinese governments at all levels, in order to provide reference for nosocomial infection prevention and control of the novel coronavirus pneumonia epidemic. It is clear that effective NOsocomial infection prevention and control in hospitals requires precise efforts in improving organizational structure, environmental transformation, material support, training and assessment, system mechanism, supervision and evaluation, continuous improvement and other aspects, and precise policies can be scientific prevention and control and achieve results.,

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Igarashi, Y., Tateishi, S., Matsuoka, J., Sawajima, T., Kawasumi, M., Harada, A.*, et al.*

COVID-19 workplace countermeasures that occupational physicians could not change in Japan: a qualitative study.

BMC Public Health, Vol. **25** n°(1), (2025), 93 p.

During the COVID-19 pandemic, information and circumstances changed from moment to moment, including the accumulation of scientific knowledge, the emergence of variants, social tolerance, and government policy. Therefore, it was important to adapt workplace countermeasures punctually and flexibly based on scientific evidence and according to circumstances. However, there has been no assessment of changes in workplace countermeasures. With a view toward preparedness for future pandemics, we surveyed COVID-19 workplace countermeasures that occupational physicians considered as needing to be changed but went unchanged.

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Oliveira, M. D., Souza, F. C., Gomes, R. C. N., Vargas-Ferreira, F., Mattos, F. F., Abreu, M. H. N. G. D.*, et al.*

COVID-19: Factors Associated with Dental Students' Fear of Infecting their Relatives as a Result of Clinical Practice.

Pesqui Bras Odontopediatria Clin Integr, Vol. **25**, (2024)

Objective: To evaluate the factors associated with the fear of dental students infecting their relatives with COVID-19 as a result of clinical practice.

Material and Methods: Online questionnaires were sent by e-mail and social media to dental students from a Brazilian School of Dentistry. The outcome was "fear of infecting the family." The independent variables were sociodemographic data, personal protective equipment use, adoption of infection control measures, and knowledge and feelings about the pandemic and the future of Dentistry. Data analysis used Pearson's Chi-square and Fisher's exact tests (p≤0.05).

Results: With 65 participants, the prevalence of fear was 61.5%. Measures to prevent COVID-19, such as frequent hand cleansing (p=0.028) and avoiding the use of aerosol-generating instruments (p=0.027), not having or not knowing if they have been infected by the disease (p=0.038), and feelings of more significant

anxiety during the pandemic period (p=0.047), and that Dentistry will undergo major post-pandemic changes (p=0.020) were associated with fear.

Conclusion: Changes in behavior about biosafety and feelings of anxiety and uncertainty about the disease were associated with the dental students' fear of infecting their relatives with COVID-19 as a result of clinical practice.

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Mustafa, M., Cook, M. J., Mcleod, R. S.

A critical review of ventilation effectiveness in naturally ventilated spaces from the perspective of sustainability and health.

Building and Environment, Vol. **270**, (2025)

Ventilation effectiveness is a term which describes the ventilation supply air distribution characteristics in a space. The metrics used to assess ventilation effectiveness have a direct bearing on important design factors including, energy efficiency, indoor air quality and airborne infection risk. This study provides a critical review of the ventilation effectiveness literature, to document: i) the relationship between ventilation effectiveness and its relevant fields of application, ii) state-of-the-art knowledge of ventilation effectiveness in naturally ventilated buildings, iii) major shortcomings in the use of these metrics in the field and iv) recommendations for improvements in the application of such metrics. The findings show that ventilation effectiveness studies in naturally ventilated buildings are relatively sparse and are often poorly implemented. In contrast, there has been much more work applying ventilation effectiveness concepts to mechanically ventilated spaces. Furthermore, critical analysis of ventilation effectiveness studies in naturally ventilated systems reveals that there are considerable shortcomings in existing studies. Common issues included: poor adaptation of methods intended for mechanically ventilated spaces to naturally ventilated spaces, drawing potentially misleading conclusions based on misapplication of established metrics, and a lack of robustness in the use of computational fluid dynamics methods for modelling ventilation effectiveness. These shortcomings highlight the urgent need for ventilation effectiveness research focused on providing a better understanding of the influential parameters, in relation to designing and operating healthier and more energy efficient naturally ventilated buildings.

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Griffith, H., Ruiz-Martin, C., Wainer, G.

A Discrete-event modeling method to study human behavior for spread of diseases on university campuses.

Computers & Industrial Engineering, Vol. **200**, (2025)

The COVID-19 pandemic has highlighted the importance of defining sound policies to make attending workplaces safer. Sometimes, deciding on different policies is challenging as this highly depends on the behavior of the individuals. This research introduces a Discrete Event-based methodology and a prototype implementation to study such policies, including human behavior along with information about the workplace layout and building characteristics such as ventilation rate or room capacity. The method is based on a combination of agent-based models, diffusion processes and discrete-event simulation. We exemplify how to use this method using a case study based on Carleton University’s Campus, in which we use the methodology and tools to study the effect of ventilation, as well as the application of a policy where sick students are denied entry to the campus on the number of disease cases on campus.

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Pei, G., Azimi, P., Rim, D., Allen, J. G.

Effect of Portable Air Cleaner Placement on Airborne Infection Control in Learning Environments.

Event18th International Conference on Indoor Air Quality and Climate, INDOOR AIR 2024 - Honolulu, United States. Jul 7 - 11 2024

Portable air cleaners (PACs) are crucial for minimizing airborne pathogen transmission in educational settings. This study employs a Computational Fluid Dynamics (CFD) model to optimize PAC implementation in classrooms. PACs with a clean air delivery rate of 2.6 hr-1 reduce student aerosol intake by up to 66%, particularly beneficial in poorly ventilated spaces. Strategic PAC placement, within 3 m of potential infectors or centrally in unidentified cases, enhances effectiveness. Adjusting PAC discharge height to occupants' breathing levels (e.g., 0.9-1.2 m for seated individuals) improves performance in areas with inadequate air circulation. Overall, this research provides science-based insights for maximizing PAC efficacy, emphasizing their role in mitigating disease transmission in indoor environments.

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Workneh, B., Usmani, H., Poobalasingam, A., Quach, T., Fung, A. S.

HVAC Strategies for Mitigating the Spread COVID-19 in High-Rise Residential Building.

9th International Building Physics Conference (IBPC 2024)

COVID-19 is the new norm around the world. This report evaluates high-rise residential buildings in Toronto and how best to mitigate the spread of COVID-19. Various software solutions were used to examine different aspects of this HVAC problem. Eventually, it was decided to supply air directly to each unit so everyone would receive fresh air. A higher ratio of outdoor air in the air mixture was configured. Larger ducts and more powerful fans will need to be installed. A MERV filter rating of 8 was exchanged for a rating of 16 for increased efficiency by 5%. The addition of an external air filter decreases the concentration of the contaminants by 3–4 times more than having the space without it. From the results, the HVAC system should have an Outdoor Air Fraction (OAF) of 40% and MERV-16 filters.

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Zhao, Y., Xiong, C., Luo, Z., Hussein, T., Zhao, T.

The impact of human-induced turbulence on indoor thermal environment and pollutant diffusion.

Building Simulation, (2024)

Turbulence induced by human movement is thought to affect the dispersion of pollutants in indoor environments. In this study, eight classical crowd scenarios were numerically simulated to investigate the effects of human movement on indoor air pollution in different scenarios. High-level simulations were performed into human movement, respiration, and heat dissipation, and differential analyses of the simulation results for different flow scenarios were conducted to investigate the interactions between individuals. Research has shown that people walking create significant wake currents within approximately 1.1 m on either side of their path and within 3–4 m behind them. When two pedestrians crossed paths, the wind speed increased significantly to 1.87 m/s compared with a single person walking at 1 m/s. The greatest mutual interference in pollutant distribution occurs when two individual cross paths are perpendicular, with a critical interference distance threshold of 2.87 m. Carbon dioxide concentrations fluctuate, surpassing 1,000 ppm within ten minutes at a density of 1.52 persons per square meter. Additionally, the dispersion of aerosol particles is significantly influenced by the relative direction of movement between individuals and pollutant sources. Calculated “safe distance” to avoid inhalation of exhaled aerosols in short flow exposure scenarios is at least 3.4 m. The personnel wake disturbance intensity was defined based on the rate of change in the velocity amplitude in the personnel wake region, the wake deformation rate, and the dissipation time. These insights can guide improvements in indoor air quality and health risk reduction in densely populated spaces.

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Yang, Y., Wu, J., Chen, Z., Pan, S., Hu, X., Wang, Y.

Impact of partitions on droplet transmission in a bus: A numerical study.

Physics of Fluids, Vol. **37** n°(1), (2025)

The bus cabin is a potential hotspot for virus transmission via aerosols, where social distancing cannot be strictly applied due to its confined space and large number of passengers. Therefore, this makes it important to look into how droplets travel in buses and find ways to lower the chances of catching airborne infections. In this study, we examined how partitions affect the movement of cough droplets in buses using computer simulations, and droplets with different particle sizes and infected persons in different locations were considered in the study. The flow field in the cabin was predicted using numerical computation, and the droplets emitted by the infected person were tracked with the Lagrangian method. Droplet concentrations within the breathing area of each passenger, deposition characteristics, and escape rates of droplets were analyzed. The results of the study show that the installation of partitions between passengers in the bus limits the transport of droplets in the lateral direction, which in turn promotes droplet settlement. Moreover, it can effectively reduce the concentration of droplets in the passenger breathing area, thereby reducing the chance of infection for passengers.

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Cepiński, W., Szałański, P., Orłowska, M., Janta-Lipińska, S., Ratajczak, K.

Impact of room heat load on ventilation effectiveness and probability of transmission of airborne diseases on the example of chosen scenarios.

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

The Wells-Riley model is commonly used to assess the probability of viral transmission, taking into account various factors. One of these factors is the ventilation effectiveness, which is commonly assumed to be constant. This article proposes to consider the variability of ventilation efficiency and the inclusion of an additional factor, the dependence of the variability of ventilation efficiency on the variable room heat load and the type of air distribution system in the room, in this established model. The study presents several scenarios simulating probability of airborne transmission of the Omicron variant of the SARS-CoV-2 (causing COVID-19) for typical rooms, such as an office, classroom, and auditorium, for different typical air distribution patterns ('up-up' and 'down-up'), for heat load conditions of two extreme climatic situations: summer (15 August) and winter (31st December), as well as for the maximum and minimum attendance and different types of lighting and room equipment. The study demonstrates that the variability of ventilation effectiveness, depending on the variability of the room's heat load and the air distribution system in the room, influences the probability of pathogen transmission. For an airflow system 'up - up' in classroom, the probability result after 7 h is 15.9 % in winter with minimal heat load (ventilation efficiency from 0.78 to 0.83) and 13.8 % in summer maximum heat load (ventilation efficiency constant and equal to 1.0). to 1.0). For an airflow system 'down - up' in auditorium, the probability result after 4 h is 3.8 % in winter with minimal internal heat gains (ventilation efficiency from 0.82 to 0.92) and 2.8 % in summer maximum internal heat gains (ventilation efficiency from 1.01 to 1.26). This study shows that neglecting this parameter may lead to an underestimation of the transmission risk, thus this article recommends that at least simplifies heat load model should be included in future analyses, and scenarios with different room heat loads should be evaluated separately.

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Sarbasheva, M., Makhieva, Z., Maltsagova, A., Khadzhieva, L., Dzhafarov, M.

The impact of the covid-19 pandemic on global environmental change and its consequences for human health.

Reliability: Theory & Applications, Vol. **19** n°(SI 6 (81)), (2024), 783-791 p.

The COVID-19 pandemic has had a significant impact on global environmental change, primarily through the reduction of greenhouse gas emissions and air pollution due to the sharp decline in economic activity, particularly in the transportation and industrial sectors. While these changes brought temporary environmental improvements, such as better air quality and reduced water pollution, they did not offset long-term environmental challenges. The pandemic’s effects on human health have been mixed: on one

hand, improved air quality may have reduced respiratory illness-related morbidity, while on the other hand, the economic downturn and disruptions in healthcare services negatively affected public health. The long-term implications of the pandemic highlight the need for a transition toward more sustainable economic activities and improved natural resource management to mitigate future health and environmental risks.

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Imoto, Y., Matsui, H., Ueda, C., Nakajima, E., Hanaki, H.

Inactivation Effects of Hypochlorous Acid, Chlorine Dioxide, and Ozone on Airborne SARS-CoV-2 and Influenza A Virus.

Food and Environmental Virology, Vol. **17** n°(1), (2025), 9 p.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and influenza A virus are primarily transmitted through droplets or aerosols from patients. The inactivation effects of existing virus control techniques may vary depending on the environmental factors. Therefore, it is important to establish a suitable evaluation system for assessing virus control techniques against airborne viruses for further real-world implementation. This study aimed to assess the inactivating effects of chemical substances on SARS-CoV-2 and influenza A virus in the air using an established evaluation system. A mixture containing SARS-CoV-2 and influenza A virus in diluted saliva was nebulized into the designed 1 m3 chamber, and the virucidal effects of hypochlorous acid, chlorine dioxide, and ozone in the air samples at 23 ± 1 °C with 50 ± 5% relative humidity were determined using the plaque assay. Both viral infectivity titers decreased depending on chemical substance concentration and exposure time. The concentrations of hypochlorous acid, chlorine dioxide, and ozone in the air reached an approximately 2-log reduction of SARS-CoV-2 infectivity titer within 10 min at 0.02, 1.0, and 1.0 ppm, respectively. SARS-CoV-2 persisted in the air even under conditions where the influenza A virus was inactivated below the detection limits. These findings demonstrate that hypochlorous acid, chlorine dioxide, and ozone are effective in inactivating SARS-CoV-2 and influenza A virus in the air.

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Andrup, L., Kolarik, B., Klingenberg, A. M., Stephansen, L., Krogfelt, K. A., Madsen, A. M.

Indoor air quality and symptoms of acute respiratory infections and gastrointestinal issues in children and employees in day-care nurseries.

American Journal of Infection Control, (2024)

Background Children attending day-care centers (DCCs) experience more infections than those cared for at home and DCC employees have high sickness absence rates. This study aimed to investigate the association between indoor air quality and absenteeism among children and staff in DCCs. Methods CO2 levels, relative humidity (RH), and temperature were continuously measured in 22 DCCs over 3 winter months. Simultaneously, absenteeism due to sickness was recorded for 721 children and 213 employees. In 11 DCCs, staff received training to improve ventilation. Results The median CO2 concentration, RH, and temperature were 818 ppm, 38.7%, and 20.8 °C, respectively. Acute respiratory infections (ARIs) accounted for 42% of child absenteeism and 53% of staff absenteeism, while gastrointestinal symptoms (GI) were responsible for 24.7% and 27.3% of absenteeism in children and staff, respectively. No significant association was found between ARI absenteeism and CO2 concentration, RH, or temperature. However, a significant association was observed between GI and room temperature ($P < .05$). No significant differences in CO2 concentration or absenteeism were observed between intervention and control groups. Conclusions No statistical evidence was found that ARI absenteeism was associated with the measured indoor air quality parameters. GI for staff and children was significantly associated with room temperature. Absenteeism was not associated significantly with targeted interventions.

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Kurbonova Muxabbat, X.

Infections transmitted through the air droplet.

JOURNAL OF NEW CENTURY INNOVATIONS, Vol. **67** n°(1), (2024), 240-243 p.

Annotation: This article explores infections transmitted through airborne droplets, emphasizing their mechanisms, prevalence, and methods of prevention. A detailed analysis of literature, research methodologies, results, and discussions provides insight into controlling and mitigating the spread of airborne diseases. Specific recommendations are presented for both public health authorities and individuals.

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Brady, G., Bennin, F., De Koning, R., Vindrola-Padros, C., Clark, S. E., Tiwari, M. K.*, et al.*

Interventions used to reduce infectious aerosol concentrations in hospitals—a review.

eClinicalMedicine, Vol. **79**, (2025)

Summary Background The COVID-19 pandemic highlighted the need for improved infectious aerosol concentrations through interventions that reduce the transmission of airborne infections. The aims of this review were to map the existing literature on interventions used to improve infectious aerosol concentrations in hospitals and understand challenges in their implementation. Methods We reviewed peer-reviewed articles identified on three databases, MEDLINE, Web of Science, and the Cochrane Library from inception to July 2024. 6417 articles were identified, 160 were reviewed and 18 were included. Findings Results on aerosol concentration were discussed in terms of three categories: (1) filtration and inactivation of aerosol particles; (2) effect of airflow and ventilation on aerosol concentrations; and (3) improvements or reduction in health conditions. The most common device or method that was outlined by researchers was high efficiency particulate air (HEPA) filters which were able to reduce aerosol concentrations under investigation across the included literature. Some articles were able to demonstrate the effectiveness of interventions in terms of improving health outcomes for patients. Interpretation The key finding is that infectious aerosol concentration improvement measures based on filtration, inactivation, improved air flow dynamics, and ventilation reduce the likelihood of nosocomial infections. However limitations of such approaches must be considered such as noise pollution and effects on ambient humidity. Whilst these efforts can contribute to improved air quality in hospitals, they should be considered with the other interacting factors such as microclimates, room dimensions and use of chemical products that effect air quality. Funding This study is funded by the National Institute for Health and Care Research (NIHR) (NIHR205439).

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Laxmi, K. B., Peter, J. B. J., Rajalakshmi, P., Dhivya, K., Mishra, N., Srinivasan, S.

IoT-Based Humidity Sensing and Control in Smart Hospitals k-Nearest Neighbors for Infection Control and Patient Comfort.

2024 First International Conference on Innovations in Communications, Electrical and Computer Engineering (ICICEC). 24-25 Oct. 2024

A novel method for monitoring and controlling humidity levels in smart hospital settings by means of the Internet of Things (IoT). To maximize patient comfort and infection control measures, IoT device connection allows for real-time humidity level monitoring and modification. Improving the system's responsiveness to humidity data is possible with the use of the k-Nearest Neighbors (KNN) algorithm. Machine learning (ML) method, the system can forecast the ideal relative humidity from past data and present weather. A major factor in preventing the spread of infectious diseases in healthcare facilities is keeping the relative humidity at an optimal level. The general health and success of the healing process depend on the patient's level of comfort. The proposed IoT system for smart hospital humidity management considers medical and patient needs. The system's capacity to dynamically adjust humidity levels based on data improves infection control and patient satisfaction.

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Shendell, D. G.

Learning from COVID-19: Teaching Undergraduate Students Concepts in Indoor Air and Environmental Quality Related to Human Health.

18th International Conference on Indoor Air Quality and Climate, INDOOR AIR 2024 - Honolulu, United States. Jul 7 - 11 2024

Especially for younger students, it is critical to build then assess knowledge and awareness of IAQ/IEQ and potential exposures due to pollution sources in various indoor microenvironments. Moreover, COVID-19 brought increased emphasis to online and hybrid (online and in-person) training for both continuing education of professionals but also undergraduate university/college students (UG). I created the UG version of my graduate level course addressing basic science and engineering concepts of IAQ/IEQ important to human health and safety in winter 2021, in preparation for fall semester 2021. After initial success, I offered it both semesters of three (2021-24) academic years to date.,

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Lednicky, J. A.

New questions and avenues for research regarding interpretation of the significance of respiratory viruses adrift in the air.

eBioMedicine, Vol. **112**, (2025)

Respiratory infections are the leading reason for hospitalisations worldwide.1 While numerous human respiratory viruses have been identified, the manner by which they are transmitted person-to-person is less understood than the situation with their bacterial counterparts. The same is true for the respiratory fungus Pneumocystis jirovecii. A major reason that knowledge of the transmission dynamics of respiratory viruses has lagged compared to what is known for bacteria such as Mycobacterium tuberculosis and for fungi revolves around the difficulty of collecting airborne viruses.2 Whereas airborne bacteria and fungi are readily collected from air samples using commonly used air samplers, the smaller size and low mass of virus particles makes their collection technically challenging.2 Knowledge gaps regarding respiratory virus transmission were evident during the COVID-19 pandemic, wherein many public health authorities (a) recommended frequent handwashing, and (b) maintenance of one metre distances between people to prevent or at least reduce the chances of being infected by SARS-CoV-2 via droplets. Little attention was paid at the onset of the pandemic to the risks of exposure to airborne SARS-CoV-2, whereas it is now acknowledged that inhalation exposure is the major route the virus spreads person-to-person.

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Li, T., Lei, J., Xie, Y., Luo, H., Cheng, Y.

Numerical comparison of exhaled particle dispersion and infection probability in hospital wards heated by mixing ventilation and impinging jet ventilation.

International Journal of Ventilation, (2024), 1-22 p.

Impinging jet ventilation has sufficient supply momentum to overcome thermal buoyancy, with the potential to reduce cross-infection risk in winter. Using an Eulerian-Lagrangian approach validated by experiments, this study compared the exhaled particle dispersion in a two-bed hospital ward heated by impinging jet ventilation and mixing ventilation. Exhaled particles with ten different diameters were tracked under four typical air changes per hour. Particle concentration distribution and residence time were compared. A revised Wells-Riley model was used to calculate the airborne infection probability of coronavirus disease 2019, with the help of a custom field function in Fluent software. The results indicated that impinging jet ventilation increased the air velocity in the occupied zone compared with mixing ventilation. The higher air velocity facilitated the control and removal of fine and medium particles, resulting in lower indoor particle concentration and shorter residence time for 0.5 ? 10??m particles under impinging jet ventilation. With the same air changes per hour, the average infection probability of coronavirus disease 2019 at the breathing zone of susceptible individuals under mixing ventilation could be 1.3 to 12.8 times higher than that under impinging jet ventilation. Additionally, the local infection probability at the face of susceptible individuals was

lower under impinging jet ventilation. This study showed that impinging jet ventilation can be implemented in hospital wards to reduce the cross-infection during winter. Comparison of infection probability for IJV and MV in a heating hospital ward was conducted;Numerical model was validated by experimental data;IJV reduced indoor particle load and shortened residence time of fine and medium particles;IJV had potential to reduce the cross-infection risk as compared with MV. Comparison of infection probability for IJV and MV in a heating hospital ward was conducted; Numerical model was validated by experimental data; IJV reduced indoor particle load and shortened residence time of fine and medium particles; IJV had potential to reduce the cross-infection risk as compared with MV.

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Chahardoli, S., Lesan, M., Bhattacharya, A.

Numerical modeling of airborne infectious disease transmission in a shared-office space under various ventilation strategies.

18th Conference of the International Society of Indoor Air Quality and Climate, INDOOR AIR 2024 - Conference Program and Proceedings

his study investigates the transmission of airborne infectious diseases in shared-office spaces, a critical concern post-COVID-19. Focusing on disease transmission dynamics similar to COVID-19, we utilize Computational Fluid Dynamics (CFD) to simulate airflow and pathogen dispersal in an educational facility's shared office space, incorporating ceiling-mounted exhausts, supply diffusers, and desk fans. The research critically examines the placement of diffusers and their impact on air distribution, vital for effective ventilation and contaminant control. A steady-state simulation approach explores different diffuser configurations on airborne pathogen distribution. Using the Discrete Phase Model (DPM), we model cough-generated droplet dispersion, representing pathogen transmission. The findings reveal the spatial and temporal distribution of airborne pathogens, showing how varied ventilation strategies can significantly affect infection probabilities. This research balances thermal comfort with reduced infectious disease spread risk, offering vital insights for designing safer indoor environments amidst public health challenges. It contributes to the understanding of airflow and contaminant control, aiding public health strategies against airborne diseases.,

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Sedighi, A. A., Nasiri, F., Haghighat, F.

Respiratory infection transmission risk assessment: Incorporating insights from public health strategies for population and individual behaviors.

Building and Environment, Vol. **270**, (2025)

This study aims at investigating infection transmission in indoor environments by distinguishing between individual and population-level risks. By utilizing data from numerical simulations of CO2 dispersion as a tracer gas, serving as a proxy for pathogen distribution, the concentration variation of pathogens within the space is estimated. Previous research has mainly focused on pathogen concentration contours for fixed positions of an infectious individual, which has been useful in evaluating infection transmission risk from an individual perspective. Considering the need to assess infection transmission risk from a population perspective, and recognizing the limitations of models like the Wells-Riley model (which does not account for the effects of ventilation configuration and seating arrangements), this study proposes population-based approach for estimating infection transmission risk. This method uses the CFD simulation data to evaluate infection risk from a population perspective. It is shown that population infection transmission risk is aligned with the distribution of the worst-case scenarios for everyone in an indoor space, and considering all this data together provides an overall population risk. It shall be mentioned that this study does not aim at providing a numerical value for risk; instead, the distribution of inhaled pathogens is used as an indicator of infection transmission risk. The results and methodology presented can help distinguish the differences between individual and population perspectives in infection risk assessment, and ensure that one is not mistaken for the other.

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Zhou, J., Koutsopoulos, H. N.

Schedule-based analysis of airborne transmission risk in public transportation systems.

Transportation Research Interdisciplinary Perspectives, Vol. **29**, (2025)

Airborne diseases raise the question of transmission risk in public transportation systems. However, quantitative analysis of the effectiveness of transmission risk mitigation methods in public transportation is lacking. The paper develops an airborne transmission risk modeling framework based on the Wells-Riley model using as inputs transit operating characteristics, schedule, Origin-Destination (OD) demand, and virus characteristics. The model is sensitive to various factors that operators can control, and external factors that may be subject of broader policy decisions. The model is utilized to assess transmission risk as a function of OD flows, planned operations, and factors such as mask-wearing, ventilation, and infection rates. Using actual OD and AVL data from the Massachusetts Bay Transportation Authority (MBTA) Red Line, the paper explores the airborne transmission risk under different infection rate scenarios. The paper assesses the combined impact from viral load related factors and passenger load factors. Increasing frequency can mitigate risk, but cannot fully compensate for increases in infection rates. Imbalanced passenger distribution on different cars of a train increases the overall system-wide infection probability. Spatial infection rate patterns should also be considered during policymaking. For lines with branches, demand distribution among the branches is important and headway allocation adjustment can reduce risk.

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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 infections. It's time for public health authorities to make this clear.

Journal of Infection and Public Health, (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. This is settled science, and has been for decades. 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 in order to more effectively address airborne infectious diseases.

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Zodo, G., Konka, H., Stevanovic, S., Schluter, J.

Simulation of the transition of respiratory droplets to aerosol states: Implications for pathogen spread.

Physics of Fluids, Vol. **37** n°(1), (2025)

Airborne viruses constitute a real threat to the world and will continue to do so in the foreseeable future. Despite the intensive research in this field, the physical mechanisms of the droplet dynamics and aerosols carrying these viruses are far from being fully understood. Among the many variables that have critical impact on the dispersion of the virus carrying droplets and aerosols are the temperature and relative humidity, as these primarily determine the longevity of the liquid phase of the droplets. While previous research studied the dispersion of the virus carrying droplets and aerosols due to different physical and boundary conditions, we focus on the aerosols in the range below 10 μm as these have shown to be the most likely pathway for airborne transmission. In this study, the spatial and size evolution of droplets

injected by the mouth through coughing are analyzed numerically and compared for different combinations of temperature and relative humidity. Of special interest would be tracking the aerosol droplets in part of an indoor location that serves as the volume that a conversation partner would draw breath from. We present quantitative data in dependence of temperature and relative humidity plotted against time assisting quantifying the possibility of transmission. An Eulerian–Lagrangian approach is used to study the multiphase flow consisting of a continuous fluid formed of air and water vapor and discrete droplets formed of liquid water. We present an analysis on the number of aerosolized droplets reaching a conversation partner depending on temperature and relative humidity. It was concluded that for aerosol transmission to a conversation partner, the humidity has the largest influence on the aerosolized droplets.

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Wagner, D. N., Jung, N., Boor, B. E.

Spatiotemporal Mapping of Ultrafine Particle Fluxes in an Office HVAC System with a Diffusion Charger Sensor Array.

ACS ES&T Air, (2024)

Commercial HVAC systems intended to mitigate indoor air pollution are operated based on standards that exclude aerosols with smaller diameters, such as ultrafine particles (UFPs, Dp ≤ 100 nm), which dominate a large proportion of indoor and outdoor number-based particle size distributions. UFPs generated from occupant activities or infiltrating from the outdoors can be recirculated and accumulate indoors when they are not successfully filtered by an air handling unit. Monitoring UFPs in real occupied environments is vital to understanding these source and mitigation dynamics, but capturing their rapid transience across multiple locations can be challenging due to high-cost instrumentation. This 9-month field measurement campaign pairs four medium-cost diffusion charger sensors with volumetric airflow rates modulated and monitored in a cloud-based building automation system of an open-plan living laboratory office and dedicated air handling unit to evaluate spatiotemporal particle number and surface area concentrations and migration trends. Particle number flux rates reveal that an estimated daily median of 8 × 1013 UFPs enter the air handling unit from the outdoors. Switching from a MERV14 to a HEPA filter reduces the number of UFPs supplied to the room by tens of trillions of UFPs daily, increasing the median filtration efficiency from 40% to 96%. These results demonstrate the efficacy of an optimal air handling unit’s performance to improve indoor air quality, while highlighting UFP dynamics that are not accounted for in current filtration standards nor in occupant-centered HVAC control. Scalable sensor development can popularize UFP monitoring and allow for future UFP integration within building control and automation platforms. The framework established for this campaign can be used to evaluate particle fluxes considering different analytes.

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Link, M., Shore, A., Robertson, R., Hamadani, B., Poppendieck, D.

Spectral Characteristics and Indoor Air Quality Effects of Germicidal 254 nm and 222 nm Ultraviolet Light.

National Institute of Standards and Technology Report 2024

Current Germicidal Ultraviolet (GUV) devices are designed to inactive pathogens in air at either 222 nm or 254 nm wavelengths. Previous research has demonstrated both wavelengths can produce oxidants in air (222 nm: ozone, 254 nm: hydroxyl radicals) and potentially directly photolyze some chemicals. This study sought to determine the impacts of GUV devices on indoor air chemistry in both laboratory chamber and field settings. To ensure the devices were operating using wavelengths and intensities of interest, spatial spectral irradiance measurements of one 222 nm (GUV222) and one 254 nm (GUV254) device were performed. Chamber testing to determine air quality impacts consisted of operating the above devices for four hours in a sealed chamber containing six challenge chemicals. Field testing consisted of operating the devices in an unoccupied restroom on the NIST campus. Ozone, formaldehyde, other volatile organic chemical (VOC) oxidation products and ultrafine particles were measured for each device in each scenario. In chamber experiments GUV254 generated formaldehyde and likely directly photolyzed an equivalent

amount of acetone, contributing to a minimal net change in VOC oxidation products. In addition, GUV254 generated measurable ultrafine particles in the chamber experiments, albeit less than GUV222. For GUV254, formaldehyde, VOC oxidation products, ultrafine particles and ozone generation were not measurable in the restroom. In both the chamber and restroom installation GUV222 generated ozone, VOC oxidation products and ultrafine particles. GUV222 generated quantifiable formaldehyde in chamber testing only. GUV222 was demonstrated to directly photolyze tetrachloroethylene in the chamber. Lastly, to better understand the irradiance spectrum in indoor spaces where GUV devices may be deployed, spatial and temporal changes to the 375 nm to 850 nm spectrum was examined at the NIST Net Zero Energy Residential Test Facility (NZERTF). A measurement location near a window was compared to measurement close to an internal ceiling. Indoor diurnal total irradiance and spectrums collected near the spring equinox and summer solstice were compared.

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Paunović Žarić, S., K Perović, S., Alihodžić Jašarović, E.

Towards a Model of Resilient, Sustainable and Productive Post-Covid Work Environment.

Prostor, Vol. **32** n°(2 (68)), (2024), 240-253 p.

The Covid-19 pandemic has significantly changed the work perception and attitudes of employees. The goal of this research is to identify the experience of the beneficiaries and provide guidelines to develop an optimal model of the working environment during and in the post-pandemic period. The study is focused on an anonymous survey comprising 34 combined questions conducted online among 202 responders, including general questions, the issue of working conditions in offices, manner of transforming working conditions during the pandemic and personal perception of comfort. The questionnaire is also related to transitive solutions, work from home and the accentuation of a favourite manner of work upon the end of the pandemic. The results of the questionnaire together with theoretical analyses of this research may be useful for creating a good basis for the definition of optimal work spaces in the post-pandemic period, in order to further direct the development of resilient work spaces on the territory of Podgorica, as a case study. The study may be also applied to other contexts.

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Haverinen-Shaughnessy, U., Dudzinska, M. R., Clinchard, S., Dimitroulopoulou, S., Fan, X., Jacobs, P.*, et al.*

Towards equitable and sustainable indoor air quality guidelines − A perspective on mandating indoor air quality for public buildings.

Indoor Environments, Vol. **2** n°(1), (2025)

A recent article published in Science urges mandatory indoor air quality (IAQ) standards in public spaces, focusing on protecting public health, especially against diseases such as COVID-19, but also IAQ in general (1). Given the significance of this topic to our society, this short communication aims to provide commentary on the article and further discuss the importance of establishing IAQ standards. Citing a lack of legislated standards globally, the authors (1) propose numerical limits for four IAQ parameters: particulate matter (PM2.5), carbon dioxide (CO2), carbon monoxide (CO), and ventilation rate (VR). While recognizing that most of the countries do not have any mandatory IAQ standards, it is also noteworthy that IAQ regulations or guidelines exist in more than 40 countries. We like to emphasize that successful IAQ management requires recognizing, sharing, and reviewing openly available, existing regulations and guidelines, while adapting them to regional characteristics.

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Xu, B., Xiang, X., Li, Y., Yang, L., Luo, Z., Huang, J.

Ultra-high sensitivity optical fiber SARS-CoV-2 biosensor based on triangular gold nanosheets/gold film coupling enhancement.

Opt Mater, Vol., (2025)

To tackle the demand for highly accurate and real-time diagnosis of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a highly sensitive optical fiber SARS-CoV-2 antigen sensor based on triangular gold nanosheets/gold film coupling is proposed. The coupling effect between the local surface plasmon resonance effect of the triangular gold nanosheets and the surface plasmon resonance effect of the gold film increases the local electric field, resulting in higher sensitivity and lower detection limit of the sensor, and the refractive index sensitivity of the sensor is increased to 3894.3 nm/RIU. The antigen reacts specifically with the viral antibody adsorbed on the surface of the optical fiber, which leads to a small change in refractive index, which ultimately leads to a shift in the resonance peak of the optical fiber, thus enabling antigen detection. The biosensor showed good response in the range of SARS-CoV-2 antigen concentration from 0.035 to 100 ng/mL, and the limit of detection (LOD) was 0.017 ng/mL (S/N=3). The biosensor has good selectivity and stability, possesses a short response time (10 min), which provides a new idea for the detection of SARS-CoV-2 in the biomedical field.

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O'donovan, A.

The Wideband Integrated Bioaerosol Sensor (WIBS): Revolutionizing Aerosol Detection.

Airmid Healthgroup Report 2025

The Wideband Integrated Bioaerosol Sensor (WIBS) is a powerful tool designed to detect and classify airborne biological particles in real time. It has made significant contributions to areas like environmental science, public health, and climate research. WIBS helps us understand aerosols such as pollen, fungal spores, and bacteria, which can impact our health and the environment.

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