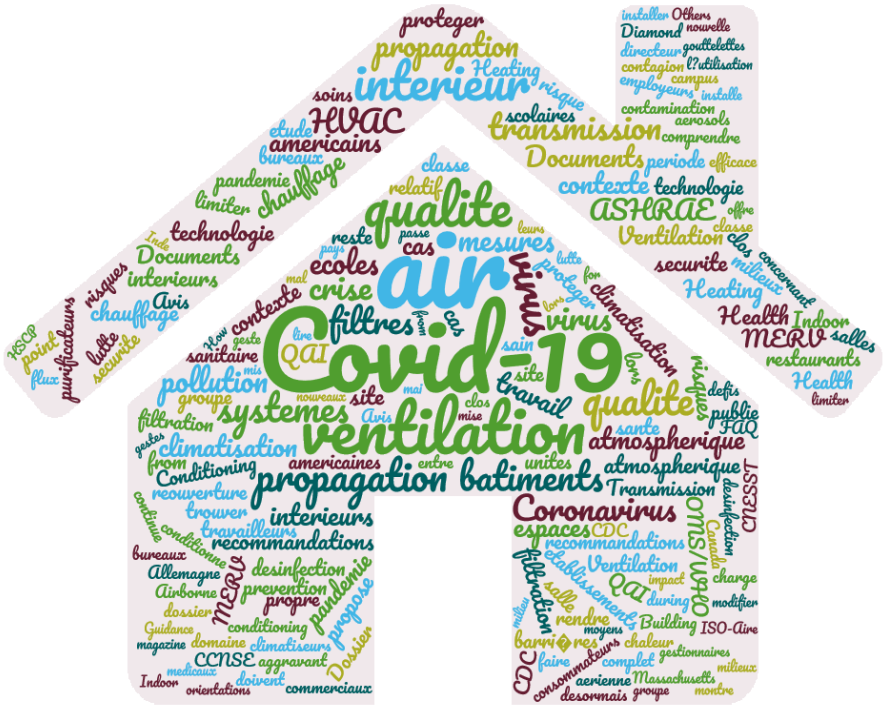

Bulletin de veille AéroCovid
N°110 – 26/02/2025

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

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Google Scholar, Lens et WoS

Charles, E., Ahmad, W., Gupta, A.

Air Pollution Control and Toxic Gas Removal.

ResearchGate, (2024)

Air pollution is a major environmental and public health concern, with harmful airborne pollutants such as volatile organic compounds (VOCs), nitrogen oxides (NOx), and sulfur oxides (SOx) contributing to respiratory diseases, climate change, and ecological degradation. This research explores advanced nanotechnology-based approaches for air pollution control and toxic gas removal. Nano-based adsorbents and catalysts provide enhanced capabilities for capturing and degrading airborne pollutants, offering sustainable solutions for cleaner air. The study examines the role of nanomaterials in adsorption, catalytic oxidation, and photocatalysis, with a focus on their efficiency, scalability, and environmental impact. Future prospects, challenges, and policy implications of nanotechnology in air purification are also discussed.

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Andersen, B., Rasmussen, T. V.

Biobased building materials: moisture characteristics and fungal susceptibility.

Building and Environment, (2025)

Climate changes make water damages and humidity problems more frequent and more severe. To combat this, inorganic building materials must be substituted by biobased materials. However, biobased materials are expected to be more susceptible to moisture and fungal growth than inorganic materials. The purpose was to stress test 14 biobased materials using three worst-case scenarios: 1) flooding, 2) leaking water pipe and 3) prolonged high humidity. The results of the stress tests showed that all 14 materials behaved differently, even materials made from the same raw material. Results showed that most materials dried out quickly after the flooding experiment, while some dissolved (clay render), lost structural integrity and became mouldy (wood fibre insulation). Results also showed that some materials (wood fibre insulation) absorbed large amounts of moisture during the high humidity experiment without becoming mouldy, while others lost structural integrity (hemp fibre insulation) or became mouldy after a month (wood chip board). When simulating leaking pipes, the results showed that some materials (wood chip board, grass-, hemp- and wood fibre insulations) went mouldy after a week, while others stayed mould free for three months. Aspergillus versicolor, A. westerdijkiae, A. niger, Chaetomium globosum and Trichoderma viride were found on most materials except hemp fibre insulation and hempcrete, while Stachybotrys chartarum was only found on hemp materials. Most materials showed good moisture buffer properties but were vulnerable to liquid water. Therefore, great care must be taken when selecting biobased materials for constructions that are at risk of water damage.

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Ismail, Z.-A.

A DCV performance in IAQ services during COVID-19: a study of the contractor in Malaysia.

Data Technologies and Applications, (2025)

Purpose Demand-controlled ventilation (DCV) plays a significant role in human life by providing safe, reliable and cost-effective services that are environmentally friendly and enhance occupant satisfaction and building energy efficiency. Significant decisions are made at the early stages of building sector DCV systems, requiring effective tools to avoid measurement errors and failures in Volatile Organic Compound

(VOC) generation. The continuous upgrading of this sector is necessary to respond to technological advances, environmental changes and increased ventilation demands. Integrating indoor air quality (IAQ) and machine learning algorithms (MLA) proves promising, as the scope of DCV typically does not extend beyond the footprint of the building; it does not encompass IAQ within a Corona Virus Disease 2019 (COVID-19) infection risk information. Therefore, integrating IAQ with MLA provides a comprehensive overview of the building sector's DCV systems. However, this integration poses challenges, particularly in DCV activities, as they are among the most complex systems involving numerous processes critical for making important decisions. This study aims to identify how digitalized construction environments can integrate DCV into their processes. Design/methodology/approach This study reviews the literature on integrating IAQ with MLA systematically, aiming to analyze the DCV need for this integration and its benefits. It proposes a direction for a conceptual framework, simulation and causal explanation of the problems using the bootstrapping technique and Cronbach's alpha factor analysis to establish the requirement for facilitating specific ventilation control processes to be incorporated into the system approaches in managing infection prevention and energy efficiency in the building sector's DCV system. Findings This study proposes a conceptual framework for analyzing IAQ within a COVID-19 context and MLA embedded in systems that may impact DCV practices. The conceptual framework comprises six key constructs: virus detection, occupant ventilation behavior, DCV energy consumption, diagnostic evaluation, temperature perception cluster and indoor environmental quality. The conceptual framework underscores the importance of early integration of DCV in the design phase to identify alternative methods to cogenerate, monitor and optimize DCV. Originality/value So far, this study advances the knowledge of how digitalized construction environments can ensure DCV delivery. The testing results highlight four significant relationships between the constructs of strategies and the constructs of occupant-density factors in the Malaysian dataset within the existing conceptual framework. Hence, the framework designed for developed countries or US companies can enhance IAQ ventilation strategy options in Malaysia's G7 contractor companies. A future study can validate the framework across the design phase with different construction stakeholders.

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Traverso Frisancho, A. J.

Desarrollo y ensamblaje de un prototipo de control y monitoreo de corpúsculos infecciosos en las salas críticas de los establecimientos de Salud del Perú.

Universidad de Ciencias y Humanidades (UCH). Thèse 2024

By the end of 2023 in Peru, contamination in critical hospital rooms has led to a high concentration of microbiological contaminants measuring 0.3 microns or larger. The pandemic period has highlighted the severe levels of cross-contamination present in the critical care rooms of health facilities, making Peru the country with the highest COVID-19 death rate in relation to its territorial population. In response to this issue, the proposed solution in this thesis is to develop and assemble, within a controlled environment, a scaled electronic prototype designed to monitor and control infectious particulate levels through parameters such as temperature, relative humidity, pressure, and particulate matter using the ESP32 microcontroller. The solution applies IoT technology to store data in the cloud and measure conditions in real-time, with the goal of future replication in the critical rooms of health facilities across Peru. The efficacy of the device design, replicated on a small scale, was demonstrated in the reduction of infectious particulates. Tests conducted in a controlled environment allowed for evaluation of its filtration efficiency and impact on indoor air quality. Key parameters—temperature, humidity, pressure, and particulate matter—were monitored and controlled based on the recommendations of ISO 14644 and ASHRAE 170 standards. This design aims for future implementation in operating rooms of healthcare facilities in Peru, within the framework of creating critical care rooms.

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Sood, A., "Cotton" Jarrell, W., Shore, X. W., Sosa, N., Parada, A., Edwardson, N.*, et al.*

Effectiveness of Frequent Point-of-Care Molecular COVID-19 Surveillance in a Rural Workplace: Nonrandomized Controlled Clinical Trial Among Miners.

JMIR Public Health Surveill, Vol. **11**, (2025)

Background: Numerous studies have assessed the risk of SARS-CoV-2 exposure and infection among health care workers during the pandemic. However, far fewer studies have investigated the impact of SARS-CoV-2 on essential workers in other sectors. Moreover, guidance for maintaining a safely operating workplace in sectors outside of health care remains limited. Workplace surveillance has been recommended by the Centers for Disease Control and Prevention, but few studies have examined the feasibility or effectiveness of this approach. Objective: The objective of this study was to investigate the feasibility and effectiveness of using frequent point-of-care molecular workplace surveillance as an intervention strategy to prevent the spread of SARS-CoV-2 at essential rural workplaces (mining sites) where physical distancing, remote work, and flexible schedules are not possible. Methods: In this nonrandomized controlled clinical trial conducted from February 2021, to March 2022, 169 miners in New Mexico (intervention cohort) and 61 miners in Wyoming (control cohort) were enrolled. Investigators performed point-of-care rapid antigen testing on midnasal swabs (NSs) self-collected by intervention miners. Our first outcome was the intervention acceptance rate in the intervention cohort. Our second outcome was the rate of cumulative postbaseline seropositivity to SARS-CoV-2 nucleocapsid protein, which was analyzed in the intervention cohort and compared to the control cohort between baseline and 12 months. The diagnostic accuracy of detecting SARS-CoV-2 using rapid antigen testing on NSs was compared to laboratory-based reverse transcriptase polymerase chain reaction (RT-PCR) on nasopharyngeal swabs (NPSs) in a subset of 68 samples. Results: Our intervention had a mean acceptance rate of 96.4% (11,413/11,842). The intervention miners exhibited a lower cumulative postbaseline incident seropositivity at 12 months compared to control miners (14/97, 14% vs 17/45, 38%; P=.002). Analysis of SARS-CoV-2 antigen detection in self-administered NSs revealed 100% sensitivity and specificity compared to laboratory-based RT-PCR testing on NPSs. Conclusions: Our findings establish frequent point-of-care molecular workplace COVID-19 surveillance as a feasible option for keeping essential rural workplaces open and preventing SARS-CoV-2 spread. These findings extend beyond this study, providing valuable insights for designing interventions to maintain employees' safety at other essential workplaces during an infectious disease outbreak.

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Narouei, F., Tang, Z., Wang, S., Hashmi, R., Welch, D., Sethuraman, S.*, et al.*

Effects of Germicidal Far-UVC on Ozone and Particulate Matter in a Conference Room.

ChemRxiv, (2025)

The application of 222 nm light from KrCl excimer lamps (GUV222 or Far-UVC) is a promising approach to reduce the indoor transmission of airborne pathogens, including the SARS-CoV-2 virus. GUV222 inactivates airborne pathogens and is believed to be relatively safe for human skin and eye exposure. However, UV light initiates photochemical reactions which may negatively impact indoor air quality. We conducted a series of experiments to assess the formation of ozone (O3), and resulting formation of secondary organic aerosols (SOA), induced by commercial far-UVC devices in an office environment (small conference room) with an air exchange rate of 1.3 h-1. We studied scenarios with a single far-UVC lamp, corresponding to the manufacturer's recommendations for disinfection of a space that size, and with four far-UVC lamps, to test conditions of greater far-UVC fluence. The single lamp did not significantly impact O3 or fine particulate matter levels in the room. Consistent with previous studies in the literature, the higher far-UVC fluences lead to increases in O3 of 5 to 10 ppb above background, and minor increases in particulate matter (16% ± 10 % increase in particle number count). The use of far-UVC at minimum intensities required for disinfection, and in conjunction with adequate ventilation rates (e.g. ANSI/ASHRAE recommendations), may allow the reduction of airborne pathogen levels while minimizing the formation of air pollutants in furnished indoor environments.

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Park, S., Lee, G., Yoon, K. J., Yoo, K.

Elucidating airborne bacterial communities and their potential pathogenic risks in urban metro environments.

Ecotoxicol Environ Saf, Vol. **292**, (2025)

Metros are the predominant mode of transportation for urban residents. Because of high passenger volume and pollutant concentrations, concern is growing regarding the potential health hazards of exposure to potential pathogenic airborne bacteria in metros. However, the risks of airborne bacterial communities in metros have not been assessed. Therefore, this study was conducted to explore the airborne bacterial communities and potential pathogenic risk of bacteria in the inner metro train (IM) and metro stations (MS) in Busan, South Korea. The concentrations of culturable total airborne bacteria (CABs) and culturable total airborne Staphylococcus (CAS) were higher in the MS samples than in the IM samples. Bacterial community analysis revealed that although the overall metro environment was dominated by human-associated bacteria, such as Corynebacterium and Staphylococcus genera, the IM and MS samples exhibited significantly distinct core bacterial taxa despite their similar bacterial communities; this is a result of human activity rather than the presence of passengers. Through multilocus sequence typing (MLST), the isolated S. epidermidis from both the IM and MS samples was identified as a human pathogen with four sequence types (ST190, ST54, ST992, and ST817). Furthermore, the MLST results were significantly positively correlated with the CABs and CASs in both the IM and MS samples. The S. aureus infection pathway was predicted in all samples using PICRUSt2 and was significantly higher in the IM samples than in the MS samples. The findings of this study can serve as a reference for developing microbial public health provisions for metro systems.

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Fan, Y., Liu, J., Han, X.

Important contributions of in-situ produced H2O2 during photocatalytic sterilization of air by self-doped Bi2.15WO6.

Sep Purif Technol, Vol. **363**, (2025)

Photocatalytic generation of oxidative free radicals is an effective method to eliminate viruses and bacteria in air. Nevertheless, the underlying mechanisms governing the gas-phase sterilization remain unclear. In this study, the self-doped Bi2.15WO6 was synthesized to prepare the Bi2.15WO6 coating. In the presence of Bi2.15WO6 coating, the average logarithmic degradation efficiencies (LDEs) are 3.82 and 3.07 for E. coli and S. aureus, respectively under UV illumination for 12.9 s, indicating its desirable sterilization efficiencies. In addition, the sterilization rates of E. coli and S. aureus slightly decrease by 3 % and 6 % after 30-repeated cycles, indicating the high stability of this catalytic coating. The 2,7-dichlorofluorescein (DCF) fluorescence experiments and SEM analysis indicate that reactive oxygen species (ROS) produced by Bi2.15WO6 have effectively destroyed cell structure to achieve the complete inactivation. The N,N-diethyl-p-phenylenediamine sulfate (DPD) and radical trapping experiments further reveal that H2O2 is the primary oxidizing species, and its yields are linearly proportional to the LDE values. The produced H2O2 is further decomposed to •OH under UV irradiation to kill bacteria. Raman analysis confirms the presence of the intermediate species of surface ≡Bi-OO• superoxo and/or ≡Bi-OOH peroxo groups on Bi2.15WO6, which are the precursors of H2O2. In addition, the 3-D filter facilitates sterilization by the Bi2.15WO6 in that it prolongs the duration of free radical via physically intercepting bioaerosols, thus apparently improving the degradation rate. This study provides new insights on the sterilization mechanism involved in the gas-phase photocatalytic processes.

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Qing, Z., Zhang, W., Zhang, W., Zhang, H., Xuan, Y.

Influence of airflow and the location of infected individuals on occupant exposure in classrooms without mechanical ventilation during the winter.

Building Simulation, (2025)

Winter poses a high risk for spreading infectious respiratory diseases, particularly in classrooms, which are known hotspots for cross-infection. The health hazards in classrooms lacking mechanical ventilation systems often go unnoticed. To address this issue, we studied the risk of respiratory infection transmission in such environments during winter by assessing the spread of contaminants using computational fluid dynamics (CFD). We evaluated four common airflow setups (split-type air conditioner, open door, open window, and both door and window open) in classrooms without mechanical ventilation. Our findings indicate that while split air conditioners provide optimal thermal comfort, they significantly increase exposure risk. Conversely, simply opening a door can effectively balance thermal comfort with a reduced exposure risk—particularly when the infected individual is near the door, leading to a minimal 0.01% average intake fraction. Furthermore, under varying ventilation scenarios, the sensitivity of exposure risk to location changes of infected individuals differs significantly. Specifically, when a split-type air conditioner is used, occupant exposure is largely unaffected by changes in the location of the infected individual. However, the exposure risk becomes highly sensitive to location changes of infected individuals when a door or window is used for ventilation. Strategic positioning of the infected individual can decrease indoor exposure risk by up to 94% with the door open and 67% with the window open. Additionally, when the door and window are both open, the dependency of occupant exposure on the location of the infected individual decreases. In this case, the exposure risk for indoor occupants is low, regardless of the position of the infected individual.

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Sabeur, A., Mostefa Tounsi, I., Morsli, S., El Ganaoui, M.

Insights on the Air Quality Story, Standard's Evolution, and IoT's Role to Monitor IAQ for an Appropriate Indoor Environment.

In: Urban Pollution - Environmental Challenges in Healthy Modern Cities. IntechOpen; 2025.

As our cities continue to grow and develop, the issue of urban pollution has become a growing concern. This problem is causing several environmental challenges that require urgent attention. The rise in greenhouse gas emissions and other toxic pollutants generated by urban areas is damaging the quality of our air and water resources. This poses a severe threat to human health and the infrastructure of our cities. The book "Urban Pollution - Navigating New Frontiers in Healthy Modern Cities" will analyse the challenges posed by urban pollution and provide potential solutions for a sustainable future. The book will cover a wide range of topics on urban pollution, including the complexities of the issue. It will offer insights to policymakers, researchers, and citizens with ideas that can be used to collaborate and create a future where access to clean air and water is a fundamental human right. By implementing these solutions, we can work toward interventions to improve the built environment and promote healthy modern cities. It is our collective responsibility to address this issue and ensure a sustainable future for ourselves and future generations.

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Kocak, O., Bunyatova, U.

Integrating smart air purifiers in building controls: A conceptual approach to infection and energy management.

Energy Reports, Vol. **13**, (2025), 2545-2554 p.

The COVID-19 pandemic has highlighted the critical need to maintain high indoor air quality. While in-duct systems are effective, their high installation costs make portable systems a more accessible and cost-effective alternative for improving indoor environments. However, energy consumption remains a key challenge with existing solutions. This study introduces the Adaptive Air Purification and Ventilation System (APVS), an intelligent technology designed to improve air quality, control airborne infections, and optimize energy use in residential and public spaces. The APVS integrates adaptive fan control with IT applications, motion sensors, and dust and virus particle sensors. Using real-time data, it dynamically adjusts ventilation based on occupancy, providing energy-efficient and effective antiviral protection. A case study was

conducted in a public administration building with 14 employees and a total indoor volume of 1170 m³ to be cleaned. The performance of the APVS was also compared to three commercially available units. Key results demonstrated the superiority of the APVS in key metrics: an air turnover rate of 4.49 units/h versus 2.61 units/h, energy efficiency per unit volume of 0.001388 kW/m³ versus 0.001412 kW/m³ , and effective air cleaning capacity of 1750 m³/h versus 1510 m³/h. In addition, its adaptive sensing technology reduced power consumption to 1.7 kW, demonstrating significant energy savings. These results establish the APVS as a sustainable, innovative solution for improving indoor air quality, reducing airborne infections, and saving energy, making it highly suitable for various applications.

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Geenen, C., Traets, S., Gorissen, S., Happaerts, M., Beuselinck, K., Laenen, L.*, et al.*

Interpretation of indoor air surveillance for respiratory infections: a prospective longitudinal observational study in a childcare setting.

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

Summary Background Sampling the air in indoor congregate settings, where respiratory pathogens are ubiquitous, may constitute a valuable yet underutilised data source for community-wide surveillance of respiratory infections. However, there is a lack of research comparing air sampling and individual sampling of attendees. Therefore, it remains unclear how air sampling results should be interpreted for the purpose of surveillance. Methods In this prospective observational study, we compared the presence and concentration of several respiratory pathogens in the air with the number of attendees with infections and the pathogen load in their nasal mucus. Weekly for 22 consecutive weeks, we sampled the air in a single childcare setting in Belgium. Concurrently, we collected the paper tissues used to wipe the noses of 23 regular attendees: children aged zero to three and childcare workers. All samples were tested for 29 respiratory pathogens using PCR. Findings Air sampling sensitively detected most respiratory pathogens found in nasal mucus. Some pathogens (SARS-CoV-2, Pneumocystis jirovecii) were found repeatedly in the air, but rarely in nasal mucus, whilst the opposite was true for others (Human coronavirus NL63). All three pathogens with a clear outbreak pattern (Human coronavirus HKU-1, human parainfluenza virus 3 and 4) were found in the air one week before or concurrent with the first detection in paper tissue samples. The presence and concentration of pathogens in the air was best predicted by the pathogen load of the most infectious case. However, air pathogen concentrations also correlated with the number of attendees with infections. Detection and concentration in the air were associated with CO2 concentration, a marker of ventilation and occupancy. Interpretation Our results suggest that air sampling could provide sensitive, responsive epidemiological indicators for the surveillance of respiratory pathogens. Using air CO2 concentrations to normalise such signals emerges as a promising approach.

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An, I.-H., Kwak, D.-B., Lee, J., Park, S.-H., Yook, S.-J.

Optimal Operating Positions of Two Air Purifiers for Improving Indoor Air Quality in Hospital Wards.

Journal of Hospital Infection, (2025)

Summary Background Maintaining high indoor air quality (IAQ) in hospital wards is crucial, particularly in settings lacking proper ventilation. This study investigates the effectiveness of air purifiers in enhancing IAQ under varying conditions, including ventilation systems and curtains. Aim This study aims to evaluate the optimal operating positions of two air purifiers to enhance IAQ in hospital wards under varying ventilation and curtain use conditions. Methods This study employed a combination of experiments and computational fluid dynamics (CFD) simulations across twenty scenarios, analysing the impact of air purifier placement on the age of air, a key IAQ metric. Findings This study found that the positioning of air purifiers greatly influenced IAQ, with reductions in the age of air ranging from 19% to 44% depending on the configuration. The most effective placement involved active ventilation systems and unfolded curtains, leading to a significant decrease in the volume-averaged age of air. Conclusion This study concludes that optimal placement of air purifiers in hospital wards can significantly improve IAQ, with reductions in the age of air

by up to 44%. Specifically, when ventilation systems were active and curtains were unfolded, the age of air was reduced to as low as 318 seconds, representing a 27% to 44% improvement over less-effective configurations. These findings emphasise the critical role of strategic air purifier placement in reducing airborne infection risks and enhancing patient safety in healthcare environments.

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Lindsley, W. G., Derk, R. C., Coyle, J. P., Blachere, F. M., Boots, T., Martin, S. B.*, et al.*

Reductions in exposures to simulated respiratory aerosols by a ceiling-mounted HEPA air filtration unit.

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

Supplemental air filtration can reduce indoor exposure to hazardous aerosols without requiring modifications to building heating, ventilation, and air conditioning (HVAC) systems. Portable air cleaners were widely used during the COVID-19 pandemic, but they can have drawbacks including noise, space obstruction, and electrical cord safety considerations. Built-in air filtration units are an alternative to provide supplemental air filtration. We conducted a case study of a HEPA air filtration unit installed in the ceiling of a conference room using radial laminar flow or square cone ceiling air supply diffusers. A respiratory aerosol simulator exhaled aerosol particles (0.3 to 10 µm), and the particle concentrations were measured in the personal breathing zones of three breathing simulators representing a speaker and two meeting participants. For the speaker, using one square cone supply diffuser reduced inhalation exposure by 49 % to 81 % while using two square supply diffusers reduced exposure by 68 % to 93 %. For the participants, the exposures were reduced by 23 % to 64 % with one square supply diffuser and 58 % to 86 % with two square supply diffusers. Results when using the radial supply air diffusers were more variable and more dependent on the simulator layouts. Combining the use of cloth face masks on all simulators with the ceiling unit reduced the speaker's exposure by 87 % to 99 % and the participants' exposures by 84 % to 97 %. In most cases the ceiling air filtration unit provided protection against simulated respiratory aerosol particles comparable to that seen previously with portable air cleaners.

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Gervásio, F. L.

Sistema IoT de monitorização da qualidade ambiental e postural.

ESTS - Escola Superior de Tecnologia de Setúbal. Thèse 2024

This dissertation presents the development of a system based on the Internet of Things to monitor environmental and postural quality in classrooms, aiming to promote students' well-being and academic performance. Specialized sensors were developed to measure parameters such as temperature, carbon dioxide, particulate matter, noise, lighting, and posture. The system integrates smart chairs equipped with sensors and artificial intelligence algorithms to evaluate postures and vital signs, as well as a networked system that centralizes data in an interactive dashboard. The methodology included the design and validation of prototypes, testing under different conditions, and analysis of results using metrics for precision and efficiency. The main findings highlight the system's effectiveness in continuously monitoring environmental and postural parameters, enabling real-time adjustments and contributing to healthier and more efficient learning environments. This work demonstrates a positive impact not only in educational contexts but also in other scenarios, such as hospitals and offices, showcasing the versatility of the proposed solution.