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Aéraulique et COVID-19

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Google Scholar, Lens et WoS

Wang, J., Jiang, L., Yu, H., Feng, Z., Castano-Rosa, R., Cao, S.-J.
Computer vision to advance the sensing and control of built environment towards occupant-centric sustainable development: A critical review.
Renewable & Sustainable Energy Reviews, Vol. **192**, (2024)

As urban development progresses, the built environment control has faced more critical challenges in improving energy efficiency, air quality, and environmental comfort. Occupant information (e.g., occupant status and behavior) sensing is a key but challenging aspect of built environmental control. Computer vision (CV) technology provides a new way for multi-dimensional information acquisition. However, a critical review is lacking in the cross-research area of CV and built environment control, particularly considering the technological ad-vancements following the COVID-19 pandemic. This article reviews the latest advancements in the built environment from international sources, with a focus on the research frontier in four branches: ventilation and indoor air quality control, COVID-19 control, thermal environment control, and lighting control. Through critical comparisons and analyses, it demonstrates that CV technology can effectively sense highly dynamic built environments, which greatly enhances the data dimension, resolution and accuracy compared to existing sensing technologies. Reported data shows that CV technology achieved an average detection accuracy of about 95% for occupant-related information and 86% for comfort-related information. Effective methods to improve the ac-curacy include incorporating data fusion by using other sensors, upgrading algorithms, and improving the model training. Particularly, the COVID-19 pandemic has driven the development of mask detection and social distancing detection using CV. The challenges, future trends and potential applications are discussed. This study emphasizes the need for cross-field integration of CV and built environment to facilitate the sharing of cuttingedge techniques and knowledge, which will stimulate more innovations in the future.

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O'brien, R., Heery, E., Shirilla, C., Sankhyan, S., Fowler, A., Vance, M. E.
Contributions of Cleaning Solution Residues to Indoor Organic Surface Films.
ACS ES&T Air, Vol. **1** n°(2), (2024), 129-138 p.

Indoor surfaces become coated with a thin organic film that plays important roles in indoor chemistry. The sources for these films are important to understand to improve our ability to model and predict the impacts of the films on indoor air quality. However, the majority of measurements have focused on semivolatile organic compounds. Here, we collected indoor surface films using a surface solvent extractor to enable the characterization of a wider range of organic chemicals present in the films. Surfaces sampled in different academic buildings contain residues from cleaning solutions including both ionic and non-ionic surfactants. These chemicals can be found on smooth impermeable surfaces even after wiping the cleaning solution off the surface. The chemicals may also potentially be deposited on surfaces farther away after spraying the cleaning solutions because many cleaning solutions have a spray applicator that generates aerosols with a bimodal number size distribution. These results demonstrate that a wider range of chemicals should be considered to contribute to indoor surface films and that the idea of a "cleaned surface" should be re-evaluated among laboratory studies, field studies, and models from the standpoint of organic indoor film formation and growth.

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Xia, Y., Lyu, S.

Direct numerical simulation of contaminant removal in presence of underfloor air distribution system.
Heliyon, Vol. **10** n°(2), (2024)

Indoor contaminant removal over 0.5≤FrT ≤ 5.0, 0.5≤N≤5.0, and 50≤Re≤500 was investigated numerically, wherein FrT refers to the Froude number, N refers to the buoyancy ratio, and Re refers to the Reynolds number. As demonstrated, the ventilation effectiveness increased with increasing contaminant source intensity and air supply intensity at a constant air temperature, indicating that increase the fresh air can effectively eliminate contaminants in this case. At high air supply temperatures, the heat retention time and contaminant transport was extremely short, and the fresh air induced by strong natural convection floating lift was rapidly discharged. Additioanlly, the air supply intensity had significant effects on contaminant removal. Quantification of the ventilation effectiveness under the combined effects of air supply intensity, air supply temperature and contaminant source intensity was determined based on the results of direct numerical simulations.

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Bi, Y.
Energy efficient airflow distribution methods for surgical microenvironment control in operating rooms.
NTNU. Fakultet for ingeniørvitenskap (IV). Institutt for energi og prosessteknikk. Thèse 2024

ith approximately 300 million surgeries performed worldwide each year, the operating room (OR) environment plays an important role in creating a satisfactory setting for all occupancies. However, there are currently several challenges within ORs, significantly affecting the well-being of the surgical team, patient safety, comfort, health, as well as the overall energy efficiency of the surgical environment. Surgical site infections (SSI) pose a significant concern within healthcare settings, ranking as the third most common type of hospital-acquired infections (HAIs). The associated risk of infection varies from 2% to 13%, leading to substantial financial costs ranging from $400 to $3,000 per infection. The primary cause of SSI is the compromised immune response of the patient, making them vulnerable to invading microorganisms. The primary source of these microorganisms is believed to be bacteria-carrying particles (BCP) released by the surgical team and patient themselves. Ventilation systems play a crucial role in mitigating the presence of BCP, yet the absence of universally accepted standards for operating room (OR) ventilation parameters impedes effective measures to reduce patient exposure to BCP threats [...]

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Kapoor, N. R., Kumar, A., Kumar, A., Arora, H. C., Kumar, A., Gaur, S.
Energy-Efficient Strategies for Mitigating Airborne Pathogens in Buildings-Building Stage-Based Sustainable Strategies.
Sustainability, Vol. **16** n°(2), (2024)

The coronavirus disease (COVID-19) pandemic has had widespread global effects. The advent of novel variants of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, along with the spread of diverse airborne viruses across different geographical locations, has caused reflective apprehension on a global scale. This resurgence emphasises the critical importance of carefully constructed structures installed with efficient ventilation systems, including both natural and mechanical ventilation techniques, as well as mixed-mode ventilation approaches in buildings. Building engineering and architectural designs must go beyond traditional considerations of economics and structural durability in order to protect public health and well-being. To attain a high quality of life, it is necessary to prioritise sustainability, energy efficiency, and the provision of safe, high-quality indoor environments. Empirical scientific investigations underscore the pivotal role played by conducive indoor environments in averting the transmission of viral diseases such as COVID-19 and mitigating challenges associated with sick building syndrome, primarily stemming from suboptimal indoor air quality. This work provides a summary and a SWOT (strength, weakness, opportunities, and threat) analysis of

strategies designed for engineers, architects, and other experts in the field to implement. These strategies are intended for integration into new constructions and the retrofitting of extant structures. Their overarching objective is the minimisation of viral transmission within indoor spaces, accomplished in an energy-efficient manner consonant with sustainable development objectives. The significance of these strategies lies in their ability to impact changes to national and international building codes and regulations, strengthening infrastructures against probable airborne viral threats. Encompassing both object-centric and subject-centric approaches, these strategies collectively furnish a holistic framework for mitigating the dissemination of pathogens, exemplified by the SARS-CoV-2 virus and similar airborne viruses, across diverse typologies of buildings.

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Yadav, M. S., Kothare, N., Tamboli, N. K., Murallidharan, J. S., Kumaraswamy, G., Singh, A., Sinha, K.
Enhancing Ventilation of Enclosed Spaces Using CFD.
Resonance-Journal of Science Education, Vol. **29** n°(1), (2024), 97-107 p.

Airborne transmission is now acknowledged to play a prominent role in propagating several highly infectious diseases, such as COVID-19. Infected people exhale tiny droplets and aerosols bearing infectious microorganisms. These are swept up by air flows and carried over long distances, potentially exposing other nearby people to the infection. This is particularly dangerous in indoor spaces, where infectious aerosols can be present in the air for a longer duration. Therefore, ventilation of spaces like classrooms, public transport and shared facilities, and aerosol transport have become active areas of study in the context of COVID-19.

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Lee, B. G., Kim, Y. J., Shim, J. E., Lee, H., Yeo, M.-K.
Estimation of microbial inhalation exposure and prediction of microbial concentrations in rail transportation facilities during the COVID-19 pandemic.
Aerosol Science and Technology, Vol., (2024), 1-14 p.

Transportation facilities are characterized by high population density and significant passenger turnover. These environments provide optimal conditions for the transmission of airborne microorganisms. We collected airborne microbial samples in transportation facilities in the Republic of Korea and characterize bacterial and fungal communities, and respiratory disease-associated viruses using qPCR, and derived regression equations. inhalation exposure levels were estimated based on the air concentration of microbiomes and the average weight and inhalation rate of Koreans. Microbial copy numbers were compared for significant differences based on facility type and season. The concentrations of bacteria ($p < 0.001$) and influenza A virus ($p < 0.01$) differed depending on the facility, whereas fungi showed variations based on the season ($p < 0.001$). Significant variations were noted, particularly in relation to the human rhinovirus, both in terms of seasonal patterns ($p < 0.05$) and between different facilities ($p < 0.05$). We found that human adenovirus ($p < 0.01$) and influenza A virus ($p < 0.05$) were positively influenced by particulate matter, while human rhinovirus was negatively affected by temperature ($p < 0.05$). Bacteria were positively influenced by CO2 ($p < 0.001$) and particulate matter ($p < 0.01$), whereas fungi were positively influenced by relative humidity ($p < 0.001$). The microbial inhalation exposure level among male children exceeded that among adult males ($p < 0.05$). Additionally, inhalation exposure to microbes was higher in trains than in train stations, which was attributed to the differences in usage times.

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Peters, T., Zhen, C., Shen, X., Vishnu, P., Bishop, D.
Evaluating Indoor Air Quality Monitoring Devices for Healthy Homes.
Buildings, Vol. **14** n°(1), (2024)

In light of COVID-19, people are increasingly anxious about indoor air quality data in places where they live and work. Access to this data using a consumer-grade air quality monitor has become a way of giving agency to building users so that they can understand the ventilation effectiveness of the spaces where they spend their time. Methods: Fourteen low-cost, air quality devices marketed to consumers were tested (seven types, two of each product): AirBird, Airthings View Plus, Aranet4 Home, Awair Omni, Eve Room, Laser Egg + CO2, and Purple Air PA-1. The study focus was accuracy and useability using three methods: a low-cost laboratory setting to test accuracy for CO2; a comparison to a calibrated, research grade meter for particulate matter (PM2.5), temperature, and relative humidity; and short-term field testing in a residential environment to understand the quality of feedback given to users. Results: Relating to accuracy, all devices were within acceptable ranges for temperature, relative humidity, and CO2, and only one brand's results met the accuracy threshold with the research grade monitor when testing PM2.5. In terms of usability, a significant variation in response time and data visualization was found on the devices or in the smartphone applications. Conclusions: While accuracy in IAQ data is important, in low-cost air quality devices marketed to consumers it is just as important that the data be presented in a way that can be used to empower people to make decisions and modify their indoor environment. We concluded that response time, user-interface, data sharing, and visualization are important parameters that may be overlooked if a study just focuses on accuracy. The design of the device, including its appearance, size, portability, screen brightness, and sound or light warning, must also be considered. The act of measuring is important, and more studies should focus on how users interpret and react to building performance data.

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Tipnis, P. M., Chaware, P., Vaidya, V. G.

Guidelines for elevator design to mitigate the risk of spread of airborne diseases.

Microbial Risk Analysis, Vol. **26**, (2024)

Airborne viral transmission in confined spaces, such as elevators, could lead to the spread of diseases such as COVID-19. A quantitative study of viral transmission in enclosed spaces, with a focus on assessing the efficacy of the present ventilation methods is hard to find. Additionally, there is a lack of guidelines for viral dispersion. The non-availability of such information reduces overall effectiveness in controlling the spread of the virus. A properly designed ventilation system for the elevator car will benefit in both pandemic situations as well as non-pandemic situations, especially for people using hospital elevators. For better control of the airborne viral transmission spread, it is essential to study the airflow in elevator cars. Exposure to high-emitter coughing for one minute by a SARS-CoV-2-infected person in an elevator can increase the risk of the virus reaching the lungs by generating a viral load that may remain airborne for a long time. There is little that has been considered for lessening the anticipated viral load in the elevator car. In this paper, we use a two-step approach. The first step is the risk assessment, and the second is risk mitigation. The risk is assessed by computing the probable viral load a healthy passenger will be subjected to during the typical travel in an elevator car contaminated by the ride of an infectious person. It is seen that the ventilation provided as per the minimum permissible requirements by various international codes is inadequate to maintain the viral load in the elevator car below the risky levels. To come up with the risk mitigation strategies, the required ventilation in the car was computed using a Compu-tational Fluid Dynamics (CFD) model. Further, mathematical models are developed to enable quick calculations during the design of the elevator car ventilation system. Our CFD study shows that in the case of a 20-passenger capacity elevator car, with doors open, a 2000 Cubic Feet per Minute (CFM) airflow will disperse most of the viral load in less than one minute. In this paper, we give easy-to-follow design guidelines, and mathematical models to enable quick calculations during the design of the elevator car ventilation system. This study is useful for practicing engineers to achieve effective ventilation of the elevator car to curtail the spread of viral transmission.

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Baria, H., Nayak, S., Patel, H., Patel, R. R.

Household secondary attack rate of COVID 19 and its associated housing factors affecting transmission.
The Journal of Community Health Management, Vol. **9** n°(4), (2022)

Background: Overcrowding and household environments are high-risk settings for transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
Aims and Objectives: To calculate the household secondary attack rate among household contacts of confirmed case of COVID-19. 2) To elicit the housing factors affecting the transmission of infection. 3) To know the sociodemographic of the discharge patients.
A prospective study was conducted among the COVID 19 laboratory-confirmed discharged patients admitted at District Covid Hospital, Designated Covid health centre from period May 2020 to July 2020. Total 94 patients were able to contact telephonically. Sociodemographic details were taken after informed Verbal consent. Those who are not able to contact telephonically or didn't give consent are excluded.
Results: Household secondary attack rate is 14.5%. Mean rooms per person were 2.8 with a standard deviation of 1.38. The mean age of the patients was 39 years with a standard deviation of 14.9. A mild negative correlation between the number of positive COVID-19 cases and rooms per person (r= ?0.045, p>0.05) and mild negative correlation was seen with the number of family members and proportion of family members (positive COVID-19 cases in family/total members in the family) being infected by COVID-19 (r= ?0.20, p>0.05).
Conclusion: Infection control and preventive strategies of household transmission such as good ventilation, isolation precautions of infected person at home, household disinfecting procedures, wearing of mask at home, hand hygiene needs to be encouraged at household level to lower the Secondary attack rate before recommendation of home isolation and home quarantine measures.

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Al-Rikabi, I. J., Karam, J., Alsaad, H., Ghali, K., Ghaddar, N., Voelker, C.
The impact of mechanical and natural ventilation modes on the spread of indoor airborne contaminants: A review.
Journal of Building Engineering, Vol. **85**, (2024)

The SARS-CoV-2 pandemic has underscored the critical importance of ventilation in mitigating indoor airborne pathogen transmission. Numerous studies have consistently observed aerosol transmission in poorly ventilated environments. This article aims to comprehensively review the distribution of respiratory and non-respiratory airborne contaminants across various mechanical and natural ventilation systems, identify the features of different ventilation systems, evaluate their performance in diverse contexts, and highlight their primary limitations and advantages. A total of ten mechanical ventilation systems and three natural ventilation systems were reviewed. Our analysis reveals that the efficiency of these ventilation systems varies significantly based on specific room contexts and the diverse assessment criteria employed. However, as a general trend, mixing ventilation (MV) and diffuse ceiling ventilation exhibit the highest contaminant concentrations and infection risk, while stratum ventilation consistently yields the lowest contamination levels. Notably, laminar airflow ventilation is predominantly employed in cleanrooms, and limited research has been conducted on intermittent ventilation (IV). For natural ventilation systems, window-integrated fans and cost-effective architectural modifications, such as optimizing window placement and dimensions, significantly enhance the effectiveness of cross ventilation (CV) in reducing indoor contaminants. Single-sided ventilation (SSV) consistently demonstrates poorer indoor air quality compared to MV and CV, necessitating additional air cleaning devices. Research on the efficacy of windcatcher ventilation in mitigating respiratory particle emissions is limited. Consequently, specific recommendations are provided for each ventilation method to minimize the transmission of contaminants into occupants' breathing zones. Finally, this review identifies research trends and underscores existing knowledge gaps within each ventilation mode.

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Zabihi, M., Li, R., Brinkerhoff, J.
Influence of indoor airflow on airborne disease transmission in a classroom.
Building Simulation, Vol. **17** n°(3), (2024), 355-370 p.

It has been widely accepted that the most effective way to mitigate airborne disease transmission in an indoor space is to increase the ventilation airflow, measured in air change per hour (ACH). However, increasing ACH did not effectively prevent the spread of COVID-19. To better understand the role of ACH and airflow large-scale patterns, a comprehensive fully transient computational fluid dynamics (CFD) simulation of two-phase flows based on a discrete phase model (DPM) was performed in a university classroom setting with people present. The investigations encompass various particle sizes, ventilation layouts, and flow rates. The findings demonstrated that the particle size threshold at which particles are deemed airborne is highly influenced by the background flow strength and large-scale flow pattern, ranging from 5 mu m to 10 mu m in the cases investigated. The effects of occupants are significant and must be precisely accounted for in respiratory particle transport studies. An enhanced ventilation design (UFAD-CDR) for university classrooms is introduced that places a premium on mitigating airborne disease spread. Compared to the baseline design at the same ACH, this design successfully reduced the maximum number density of respiratory particles by up to 85%. A novel airflow-related parameter, Horizontality, is introduced to quantify and connect the large-scale airflow pattern with indoor aerosol transport. This underscores that ACH alone cannot ensure or regulate air quality. In addition to the necessary ACH for air exchange, minimizing horizontal bulk motion is essential for reducing aerosol transmissibility within the room.

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Munckton, B., Rajagopalan, P.
Interaction between Thermal Conditions and Ventilation in Kindergartens in Melbourne, Australia.
Sustainability, Vol. **16** n°(3), (2024)

Kindergartens are important community facilities that introduce children to a classroom learning environment. The research aimed to examine current practices in kindergarten heating, cooling, and ventilation and investigate how IAQ and thermal comfort interact with each other at five selected kindergartens in Melbourne. This research used field measurements to investigate indoor air quality (IAQ) and thermal conditions during the COVID-19 pandemic and used CO2 concentration levels as an indicator of IAQ. The research found that high CO2 levels above recommended maximums were reached in operational kindergartens. The highest level identified during class time was 1908 ppm. Conditions outside recommended levels for thermal comfort were also recorded. A kindergarten operating with the use of both mechanical and natural ventilation was found to have lower CO2 levels than the kindergartens relying solely on mechanical ventilation. However, thermal comfort was compromised in this kindergarten. The data collected in kindergartens in their natural settings offered insights into the actual ventilation conditions in these facilities and provided baseline data for developing pandemic-resilient kindergartens. The findings are relevant to kindergartens in other countries that have dynamic window/door-opening behavior.

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Sanada, S. J., Mat, M. N. H., Yinn, W. K., Rosminahar, S. N.
Minimizing pathogen transmission through indoor environment optimization using central composite design of experiment.
Energy and Buildings, Vol. **298**, (2023)

The human respiratory emission mechanism generates virus particles such as the COVID-19 virus that exists in both aerosols and water droplets form. Trajectories of airborne pathogens transmitted from coughing are influenced by the air flow pattern surrounding the transmission source, making it challenging to predict. ANSYS Fluent 2022 R1 is employed in this study to visualize the airborne pathogen transmission in indoor

space of different environmental conditions with steady-state and periodic wind velocity. The effect of five different indoor parameters on airborne transmission is studied, which include wind velocity, air temperature, relative humidity of the air, particle residence time after emission, and the physical distancing of 3 feet, 6 feet, and 10 feet between two humans. The characteristics between airborne transmission and varying indoor conditions have motivated this study to correlate their dynamic relationship. Due to the limitation in controlling indoor conditions, obtaining optimum indoor conditions with minimal airborne transmission remains challenging. Simulation-based design of experiment of central composite design type yields optimum indoor condition with a wind velocity of 4.337 m/s, air temperature of 24.26 degrees C, and relative humidity of 40.14% showed 58.14% reduction in deposited particle mass relative to the base condition at a similar physical distancing of 3 feet. Surrounding air with higher relative humidity leads to a larger mean diameter of particles due to the hygroscopic growth effect. In comparison, the evaporation effect dominates in lower air humidity, leading to particle shrinkage. Particle deposition from human to human is lower with longer distances between humans, with comparable behaviour of particle transmission at each successive time step, suggesting prolonged exposure risk of the healthy individual as time progresses. This research focuses on adopting engineering simulation to find optimum indoor conditions with minimal human-to-human airborne transmission to strengthen safety and health judgement during a pandemic.

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Ticona, J. P. A., Nery, N., Jr., Hitchings, M., Belitardo, E. M. M. A., Fofana, M. O., Dorión, M.*, et al.*
Overestimation of SARS-CoV-2 household transmission in settings of high community transmission: insights from an informal settlement community in Salvador, Brazil.
Open Forum Infectious Diseases, (2024)

The SARS-CoV-2 Omicron variant has spread globally. However, the contribution of community versus household transmission to the overall risk of infection remains unclear.Between November 2021, and March 2022, we conducted an active case-finding study in an urban informal settlement with biweekly visits across 1174 households with 3364 residents. Individuals displaying COVID-19-related symptoms were identified, interviewed along with household contacts, and defined as index and secondary cases based on RT-PCR and symptom onset.In 61 households, we detected a total of 94 RT-PCR-positive cases. Out of 69 sequenced samples, 67 cases (97.1%) were attributed to the Omicron BA.1* variant. Among 35 of their households, the secondary attack rate was 50.0% (95%CI 37.0–63.0%). Women (RR = 1.6; 95%CI = 0.9–2.7), older individuals (median difference = 15; 95%CI = 2–21), and those reporting symptoms (RR = 1.73; 95% CI = 1.0–3.0) had a significantly increased risk for SARS-CoV-2 secondary infection. Genomic analysis revealed substantial acquisition of viruses from the community even among households with other SARS-CoV-2 infections. After excluding community acquisition, we estimated a household secondary attack rate of 24.2% (95%CI 11.9–40.9%).These findings underscore the ongoing risk of community acquisition of SARS-CoV-2 among households with current infections. The observed high attack rate necessitates swift booster vaccination, rapid testing availability, and therapeutic options to mitigate COVID-19's severe outcomes.

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Bastien, M.-É.
Portrait des éclosions de COVID-19 dans les milieux de travail de la Montérégie.
Université de Sherbrooke. Faculté de médecine et des sciences de la santé. Thèse 2024

La pandémie de COVID-19 constitue un défi de taille pour la santé publique, avec des conséquences directes et indirectes importantes. Dans ce contexte, il est crucial de développer et de perfectionner des stratégies afin de réduire la transmission de cette maladie au sein de la population. C'est dans cette optique que le présent projet se focalise, mettant particulièrement l'accent sur la transmission du SRAS-CoV-2 dans les milieux de travail (MT) de la Montérégie. Objectif : Décrire les éclosions de COVID-19 dans les MT de la région de la

Montérégie, Québec, Canada, et évaluer les facteurs de risque potentiels pour l'identification d'au moins une éclosion de COVID-19 dans ces MT.

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Špela, Š., Andrew, E., Greta, F., Stephane, B., Carlos, G., Matti, T. J. H., Yaneer, B.-Y.
SARS-CoV-2 and COVID-19: From Crisis to Solution.
WHN Science Communications, (2024)

The global impact of the COVID-19 pandemic persists, causing significant harm. Extensive evidence indicates that even mild infections and reinfections can result in symptomatic and subclinical health damage, disability, and persistent infection. Vascular impacts, neurotropism, and immune dysregulation lead to impaired organ function, increased morbidity and mortality, compromised work productivity, and a decline in overall health and quality of life. The uncontrolled spread of the virus is accelerating its evolution, outpacing the effectiveness of vaccines, treatments, and immune system adaptation. This preventable disease and others magnified by immune dysfunction are driving staff shortages, supply chain disruptions, and overwhelming healthcare systems. Despite the dire nature of the current conditions, knowledge and means are present to solve these problems. We present a science-based strategy for confronting the ongoing pandemic, including reducing airborne transmission through clean indoor air programs comparable with historical clean water programs. Public and professional education on the implications of repeated SARS-CoV-2 infections and utilizing known preventive measures can dramatically reduce transmission, which in turn reduces the rate of new variant introduction and strengthens the effectiveness of vaccines and treatments. It is essential to restore the prioritization of health and safety in healthcare and society.

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Zhong, J., Zhang, W., Wang, X., Zhan, J., Xia, T., Xie, L., *et al.*
Study on Airflow Distribution and Energy Conservation in a BSL-4 Laboratory Involved in Aerosol Infection Risk.
Sustainable Cities and Society, Vol. **100**, (2024)

In recent years, COVID-19 has occurred frequently in the world. The biosafety level 4 (BSL-4) laboratory personnel are at risk of being infected by bioaerosols. The high demand for fresh air makes the energy consumption of the laboratory far greater than that of ordinary buildings. This study aimed to propose a suitable air distribution design and reduce the energy consumption of the BSL-4 laboratory, which is beneficial for creating a healthy and green built environment. Firstly, the diffusion characteristics of aerosols, infection risk under different air distributions, and ventilation parameters were analyzed in depth. Secondly, from the perspective of negative pressure control, the influence of parameters such as air tightness and air changes on the airflow in multizone was discussed. The results indicated that the aerosol concentration under the same conditions of the upper supply-upper exhaust is 1.4 times higher than that of the upper supply-bottom exhaust after the airflow stabilizes. The impact of eddy currents on pollutant diffusion is weakened when the air supply velocity reduced from 1m/s to 0.8m/s. Finally, the energy-saving operation strategy was proposed with the optimized ventilation parameters. The results showed that this operation scheme reduced the energy consumption of the laboratory by 15-30%.

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Mehta, N., Kozielska, B.
A systematic literature review and bibliometric analysis of sources and analytical approaches of indoor microplastics.
Emerging Contaminants, Vol. **10** n°(1), (2024)

This systematic review and bibliometric analysis offer a comprehensive exploration of microplastics (MPs) in indoor air environments up to 2023. This article provides robust insights into the most recent advancements, source identification, and suitable analytical methodologies for emergent indoor pollutants. The systematic review was performed according to PRISMA guidelines. The selection procedure involved searching three prestigious journal databases, Web of Science, Scopus, and PubMed, with a variety of search queries and stringent inclusion and exclusion criteria. The bibliometric analysis provides a quantitative assessment of the global research output, revealing a notable upsurge in scholarly activity commencing in 2017, potentially catalysed by the heightened awareness of indoor air quality issues amid the COVID-19 pandemic. Key publication sources, such as "Science of the Total Environment" and "Environmental Pollution," are outlined to shed light on the academic conduits in this field. In addition, the analysis reveals a hierarchy of research output, with China at the top of the list, followed by Australia, Iran, and Spain. Collaborative research efforts between the United States and China have become a prominent feature of the research landscape as a result of this prolific output. The review highlights the need for standardised protocols in the collection, preparation, and examination of indoor MP samples. The significant role ventilation systems play in the dispersion dynamics of MPs in confined spaces is evaluated. Regarding the prospective sources and properties of indoor MPs, this review's findings can raise awareness among architects, interior designers and product designers, as well as researchers.

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Boulic, M., Bombardier, P., Zaidi, Z., Russell, A., Waters, D., Van Heerden, A.
Using trickle ventilators coupled to fan extractor to achieve a suitable airflow rate in an Australian apartment: A nodal network approach connected to a CFD approach.
Energy and Buildings, Vol. **304**, (2024)

The level of airtightness is increasing in newly built Australian apartments. Due to the COVID-19 pandemic, restrictions have forced many people to work from home. An appropriate ventilation rate is needed to decrease virus transmission and provide occupants with a healthy environment. As occupants tend not to open windows, they need to be informed about the potential benefit of using trickle ventilators, in connection with exhaust systems, to ventilate their apartments. In 2022, a provision for lower rates of continuous ventilation (10 L.s(-1) for the bathroom exhaust system and 12 L.s(-1) for the kitchen exhaust system) was considered for inclusion in the National Construction Code of Australia. This provision was not adopted; however, this is still a valid reference for good practice. Based on this provision for continuous ventilation, our study aims to investigate the airflow velocity and the ventilation efficiency to remove the carbon dioxide (CO2) generated across winter and summer seasons in a Melbourne apartment occupied by two adults and a child over four hours. The study's objectives are 1) to connect two modelling approaches (Computational Fluid Dynamics and nodal networks), and 2) to investigate the potential benefits of using trickle ventilators across winter and summer seasons. The results show that wind conditions have limited effects (4% decrease in the extracted air flow rate) if the extraction network output is protected from the wind. Comparing winter and summer conditions, we found that indoor airflows differed, highly influenced by the temperature difference between outside and inside. We observed that the airflow patterns were more inclined to create "CO2 pockets" during winter, which could increase virus transmission due to ineffective ventilation in this area. However, in winter, ventilation performed better in reducing the CO2 concentration in the kitchen/living room area and the whole apartment than it did during summer.

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Makihira, Y., Okumura, Y.
Ventilation design of tour buses for suppressing airborne transmission and highly efficient virus elimination in post COVID-19 period.
Mechanical Engineering Journal, (2024)

Measures to prevent the spread of COVID-19 are critical across the globe. A tour bus can carry passengers; however, the small, closed space becomes congested owing to their presence for long periods. Therefore, there is an increased risk of infection on tour buses. The air outlet of the air conditioner in a tour bus was designed to prioritize heating and cooling over ventilation. This study aims to improve the ventilation performance of tour buses. Therefore, a large-scale ventilation simulation was performed using a supercomputer. The results are as follows: (1) when the overall air flow rate of the ventilation is fixed, new outlets must be installed in the upper rear part of the tour bus for rapid ventilation; and (2) the ventilation efficiency was higher when a few high-output outlets were installed instead of several low-output outlets. The reason for the more effective ventilation was to create a large airflow in the tour bus. We proposed the design of a highly efficient ventilation system in an existing bus space and elucidated the appropriate layout of ventilation outlets and the optimal protocol for opening windows.

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Mickenautsch, S.
What is the current evidence for aerosol exposure in restorative dentistry? [October 13, 2021].
Journal of Minimum Intervention in Dentistry, Vol. **17** n°(1), (2024), 7-9 p.

Search result: A total of 8 trial reports and 4 review articles, particularly related to COVID-19 were found. Clinical outcomes: The trial results show higher aerosol exposure during use of high-speed rotating instruments than during dental procedures without. In addition, significantly higher aerosol levels were found during rubber dam use (a procedure particularly associated with placing composite resin tooth restorations). The sampling wards were significantly higher at the distances of 0.5 m. However, the use of additional extra oral high volume suction reduced aerosol. State of evidence and recommendations: The quality of the existing evidence requires further assessment. [?Preliminary Systematic Literature Searches? are based on SYSTEM?s periodic systematic searches of the dental literature and provide first overviews over existing clinical evidence but are limited in the number of databases searched, as well as the assessment of precision and internal validity of results and thus do not replace the need for a full systematic review report to the topic]

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Anggraeni, I., Dewi, O. C.
The wind flow in I-CELL building of Universitas Indonesia: Student assignment in dealing with COVID-19.
AIP Conference Proceedings, Vol. **2710** n°(1), (2024)

This paper aims to investigate the wind flow in a building that has been built and equipped with a Heating, Ventilation, and Air Conditioning (HVAC) system. With the number of COVID-19 cases still increasing every day, society and the environment must adapt to conditions that require high awareness of everyone’s health. Based on previous research, it is proven that the possibility of airborne dispersal is higher in a full room, such as a classroom. One of the important health protocols is to emphasize good ventilation so that indoor air circulation can run perfectly. The notion of the passive design itself refers to the architectural design strategies used by designers to develop designs based on environmental conditions. The concept used to achieve passive design is to increase the comfort of building users. Observations were made on the 5th floor of the i-CELL building, an integrated engineering laboratory building in Universitas Indonesia, as a typical floor sample in a building to obtain data on the existing state of the building. Observations were made by measuring existing data and then simulating the recommendations for passive cooling optimization as a design intervention. As a result of this study, the recommendation to use sun shading to direct the wind into the building could potentially cause an increase of indoor airflow.

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