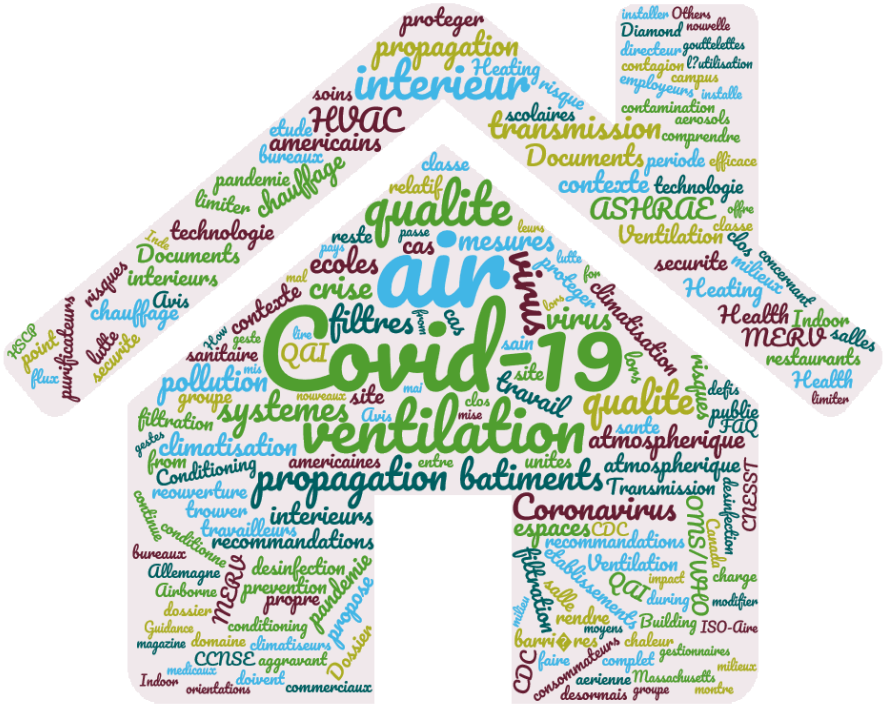

Rapport de veille n° 104

Aéraulique et COVID-19

20/11/2024

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Google Scholar, Lens et WoS

Chakrabarty, R. K.
Air Quality Monitor.
BREATHE Matchmaking Webinars. 2024

Airborne transmission is the dominant pathway for the spread of several pathogens.
• Real-time surveillance of these airborne pathogens will mitigate outbreaks.
• We have developed a customizable environmental pathogen Air Quality (pAQ) monitor comprising a wet cyclone particle into liquid collector and a liquid handling unit integrated with a multiplepathogen detection platform.

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Yao, T., Lin, Z.
Air Terminal Layout of Stratum Ventilation.
In: Stratum Ventilation—Advanced Air Distribution for Low-Carbon and Healthy Buildings: Working Principles, Design and Operation Methods, and Application Scenarios. Springer Nature Singapore; 2024. 89-108 p.

This chapter investigates the influence of air terminal layout on the performance of stratum ventilation using a combination of experimental and numerical methods. The experimental findings demonstrate that both the exhaust location and the supply air flow rate significantly impact the air diffusion performance. Simulation results demonstrate that the exhausts at the bottom of the wall in the occupied zone lead to improved air mixing. This configuration contributes to enhanced thermal comfort and indoor air quality. Furthermore, optimal levels of thermal comfort and air quality are achieved when the exhausts are placed at a lower level along the same wall as the supply air outlets, resulting in space savings for installation. Consequently, this particular air terminal layout is preferred for the design of stratum ventilation systems, provided that the performance requirements are met.

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Shoukry, F., Goubran, S., Tarabieh, K.
Anticipating Emerging Research Frontiers Related to Indoor Air Quality: What Did We Learn from the COVID-19 Pandemic?
Journal of Sustainability Research, Vol. **6** n°(3), (2024), e240050 p.

Background: While the COVID-19 pandemic has officially ended, it remains a significant era that profoundly tests humanity's ability to solve challenges across various domains related to health hazards' crisis management, technological innovation, and requestioning the management of Indoor Air Quality (IAQ) in different building typologies.
Methods: This study examines early publications related to IAQ during the early phase of the pandemic, from March 2020 to August 2021, to identify thematic research areas anticipated to shape the scientific community's future interests for at least the following 10 years. This study proposes an analytical framework to further interpret the identified thematic areas of research related to IAQ based on intentionality and impact.
Results: Topics included the spatial design of indoor environments, occupants' health, thermal comfort, building performance and ventilation, technology use and energy efficiency, as well as health and social equity. The authors commented on key topics requiring immediate attention from architects, building operators, and researchers.

Conclusions: This review foresees the need for (1) building codes that balance spatial design and health aspects to reduce the rate of viral transmission, (2) carbon footprint reduction plans in response to IAQ ventilation requirements, and (3) ventilation systems that consider the thermal comfort of occupants, minimize energy losses, and safeguard air quality from external pollutants. Finally, (4) find a balance between the identified parameters to enhance the IAQ system control.

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Kumar, A.
Building resilience to airborne pathogens: An indoor air quality model.
In: Clean Energy. CRC Press; 2024. 318-333 p.

The ongoing coronavirus disease (COVID-19) pandemic continues to escalate, profoundly altering the lives of billions of people worldwide. Meteorological parameters have been identified as inevitable factors contributing to the exponential spread of SARS-CoV-2. Poor air quality, exacerbated by modern lifestyle choices, has influenced the potential for airborne spread of the virus in indoor environments, underscoring an urgent need to improve the Air Quality Index (AQI). While lockdowns imposed due to COVID-19 temporarily improved the AQI, this alone is insufficient to fully address the problem. Although effective drugs and vaccines are available, they are not sufficient for safeguarding public health. It is important to limit or slow the spread of the coronavirus. Ventilation and air cleaning can be one important element in reducing the risk of airborne transmission indoors. This chapter reviews the AQI, explores the relationship between air quality and coronavirus transmission, assesses the impact of lockdowns on air quality, and discusses various air purifying filters that can reduce the transmission risk and improve indoor air quality. Based on these studies, a smart room management model is proposed to enhance indoor air quality.

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Happaerts, M., Geenen, C., Michiels, J., Gorissen, S., Swinnen, J., Beuselinck, K.*, et al.*
Centralised Air Sampling From a Ventilation System for the Surveillance of Respiratory Pathogens.
Indoor Air, Vol. **2024** n°(1), (2024)

Background: The COVID-19 pandemic has triggered a renewed interest in indoor air sampling for infectious disease surveillance. However, scalability is currently limited, as samples are usually collected in a single indoor space. An alternative is to place the device within a heating, ventilation, and air conditioning system (HVAC), but this approach has not been tested against room air sampling. Methods: In this observational study, we sampled the air in an indoor fitness centre for 2 or 6?h, simultaneously in three locations of the main exercise hall and in the return plenum of the HVAC system. Samples were collected twice weekly for 11 weeks. All samples were tested for 29 respiratory pathogens using PCR. We compared the ventilation system and exercise hall air with regard to the presence and quantity of pathogens. Findings: Samples collected in two locations in the exercise hall had a similar overall sensitivity to the HVAC sampler for detecting pathogens, while a third sampling location was associated with significantly lower sensitivity. Overall, the pathogen concentration was similar in the ventilation system and the exercise hall air (ratio: 1.0; 95% CI: 0.8?1.3). Interpretation: Our results show that air sampling within a ventilation system can have equal sensitivity for detecting respiratory pathogens, compared to room-based sampling. Thus, placing samplers within central ventilation systems could increase the scalability of air sampling for infectious disease surveillance.

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Jia, W., Wang, Q., Lung, D. C., Chan, P.-T., Wang, P., Dung, E. C.-H.*, et al.*
Co-existence of airborne SARS-CoV-2 infection and non-infection in three connected zones of a restaurant.
Journal of Hazardous Materials, Vol. **480**, (2024)

The lack of knowledge on quanta generation rates presents a major obstacle to specifying the minimum ventilation required to prevent airborne infections. The expected largest quanta generation rate of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by a super-spreader remains unknown. Here we investigated a SARS-CoV-2 outbreak during lunch in a restaurant using epidemiological, whole-genome sequencing and environmental analyses. Both tracer gas and fine particles were used in field experiments to quantify aerosol dispersion and removal across three interconnected zones: Zone A, Zone B and Zone C. All 21 secondary patron infections occurred in Zone B. This unique infection feature and measured dilution flow rates allowed us to estimate the largest reported quanta generation rates to date, ranging from 1724 to 1968 quanta/h. These rates were sufficiently high to cause a high attack rate in Zone B but did not cause infections in Zones A and C, likely due to sufficient dilution and insignificant contaminated airflow from Zone B, respectively. Our finding of the largest quanta generation rate so far suggests that avoiding secondary infection by dilution alone in the presence of a super-emitter might not be possible in typical air-conditioned buildings and other prevention strategies need to be developed.

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Rahmanparast, A., Bacak, A., Camci, M., Karakoyun, Y., Acikgoz, O., Dalkilic, A. S.
A comparison of heating and cooling systems having radiant and ventilation systems regarding thermal comfort.
J Therm Anal Calorim, (2024)

Thermal comfort is crucial for indoor environmental quality, impacting occupant well-being and intellectual productivity. Despite the widespread use of HVAC technologies in residential and commercial buildings, there is growing awareness of thermal comfort, leading to more studies on this issue. According to international publication indexes nearly 60% of publications belongs to the categories of construction building technology, energy fuels, and civil engineering. It should also be noted that 40% of world energy consumption pertains to construction sector. In this context, radiant cooling and heating systems come forward with their low exergy destruction rates pointing out the potential to be energy-efficient due to their higher and lower operation temperatures. Displacement ventilation, with its low heating and cooling capacity, has not gained widespread preference. However, the increasing consciousness of global warming and energy efficiency, along with the fear of airborne virus contamination, views stand-alone or hybrid applications of radiant heating/cooling and displacement ventilation as potential future solutions. This review study investigates the impact of radiant heating/cooling and ventilation types, mixing, and displacement on thermal comfort performance, focusing on factors affecting thermal comfort in trending radiant cooling and heating applications like radiant walls, ceilings, and floors. The study emphasizes the importance of considering occupant preferences, building characteristics, and energy efficiency when choosing the most suitable heating and cooling systems for different indoor environments. Stand-alone and hybrid applications of radiant heating/cooling and displacement systems can enhance thermal comfort performance, with the exception of specific cases requiring a high thermal load or ventilation rate.

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Boukaf, M., Fadli, F., Meskin, N.
A Comprehensive Review of Digital Twin Technology in Building Energy Consumption Forecasting.
IEEE Access, (2024)

With the global rise in urban populations, energy consumption in buildings has become a critical issue, now accounting for about 30% of total global energy use. Developing powerful energy forecasting systems is challenging due to frequent fluctuations in energy demand. The digitalization of building energy forecasting systems, enhanced by Energy Digital Twin technology alongside IoT devices and advanced data-driven algorithms, offers substantial improvements in energy management and optimization, servicing, maintenance, and energy-efficient design. This paper not only presents a literature evaluation categorizing the applications

of digital twins in energy consumption forecasting but also conducts a thorough review of digital twin architecture and existing energy forecasting models through a systematic literature review (SLR) approach. This methodology enables the classification of studies into areas such as overall energy consumption prediction, HVAC system performance, and indoor air quality improvement, furthering the pursuit of net-zero and positive energy buildings as well as more effective energy systems. Furthermore, the findings and discussions presented in this paper potentially initiate future perspectives in developing a powerful digital twin system for energy forecasting in buildings and underscore the need for further research to address existing gaps and enhance the development of digital twins in building energy management, thereby meeting the sector's dynamic needs and contributing to global sustainability efforts.

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Ardakani, V. G., Dorri, M., Zang, B., Nobbs, A. H., Cross, S., Gambaruto, A. M.
Computational and experimental investigation of an aerosol extraction device for use in dentistry.
Journal of Aerosol Science, Vol. **183**, (2025)

Medical procedures carry a high risk of pathogen transmission from patients to healthcare providers, the clinic environment, and subsequent patients. While measures such as patient mask wearing can help to reduce this danger, they may not always be possible, especially in dental treatments that need access to patients' airways. A protective device was designed and built to effectively confine airborne particles during medical procedures without interfering with medical operations. The device is evaluated and its working principles discussed. The device resembles a dome and comprises of four primary mechanisms to inhibit the spread of potentially infected aerosols during aerosol-generating procedures (AGPs) in dental surgery: (i) a physical barrier; (ii) air curtains; (iii) an extraction point; (iv) a sustained airflow ingress. Evaluation is carried out using experiments in laboratory and clinical settings, as well as high-resolution numerical simulations. Results of the numerical simulations of the prototype device show over 99% capture in its design configuration. The results from experiments also report high efficiency. A detailed analysis of the device and recommendations for future development are provided. The results from tests in the clinical setting will be provided in detail in another paper.

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Markatos, N. C., Rentoumis, I.
Computational prediction of Covid-19 transmission in internal air-conditioned environments.
3rd CONGRESS "The Capital of Knowledge". 3-5 April. 2024. University of East London

COVID-19 has had destructive consequences for health, economy and has altered every aspect of everyday human activity. The outbreak was first identified in December 2019 in Wuhan, China. The declaration of the disease as a "Public Health Emergency of International Concern" for the World Health Organization took place on January 30, 2020. Furthermore, 105,5 million cases have been reported until 06 February 2021. Public distancing in internal environments has been applied as a safety measure to prevent transmission. A controversial topic is the safe distance from person to person. The social distancing regulation, for internal public places, has been arbitrarily defined ignoring the potential aerodynamics effects of inlets, such as air-conditioning units, windows and doors. The velocity of the intake airflow has the potential to transfer a droplet from the nose or the mouth of a patient in greater than the indicated distance. The present study focuses on a model of a supermarket that includes a ventilation system and open doors. For the transmission of COVID-19 in an air-conditioned internal space, two different designs were implemented and studied. Internal shelving, furnishing and human models are also being considered. The numerical results obtained are compared with those obtained by two well-known empirical models related to the effective velocity of incoming air and the virus concentration. It is concluded that the computational results obtained in the present study are in acceptable agreement with those obtained by simple empirical models, especially when the standard k-ε model of turbulence is used. Thus, for the cases of coughing and sneezing patients, where we

studied the largest particles that sediment onto the floor, the 6-foot (≈1,82 m) rule applies well. However, pathogen-laced particles, coming for example from asymptomatic patients, travel through the air indoors when people breathe and talk. Therefore, there is not much benefit to the 6-foot rule because the air a person is breathing tends to rise and comes down elsewhere, so the person is more exposed to the average background than to a person at a distance. Future research should concentrate rather on the amount of time spent inside rather than distances. As the COVID-19 pandemic is progressing, the present study is flexible and can be applied generally in crowded places. Furthermore, the general outcome is that individuals should maintain the distance of 1,65 meters and it should be applied as guidelines to help reduce the infection risk.

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Wang, H., Tan, J.
Data-enhanced convolutional network based on air conditioning system start/stop time prediction.
International Journal of Refrigeration, Vol. **169**, (2025), 372-382 p.

Most enterprise workshop operators frequently adjust the start/stop time of air conditioning systems based on indoor and outdoor temperatures and humidity to accommodate changing demand and weather conditions. However, relying on personal subjective experience for these adjustments often leads to operational delays or energy waste due to the lack of precision in determining optimal timing. Predicting air conditioning system start and stop times is crucial for energy consumption and savings in HVAC systems. Traditional data-driven methods have been insufficient in this regard, as they mainly focus on feature mapping and overlook the dynamic coupling relationships of process variables, resulting in subpar predictions. In response to this challenge, the paper introduces a novel approach known as the Periodicity and Long-Term Convolutional Neural Network (PLCNN). This method converts one-dimensional regression prediction data into two-dimensional data containing time series features to capture the dynamic coupling characteristics of the air conditioning system while maintaining the independent variation relationships of features. Experimental results using real factory floor data have demonstrated the superior performance of the PLCNN method. Specifically, this method achieved a 14.96% lower error rate compared to the traditional method and an 8.18% improvement compared to the deep learning method. Moreover, the implementation of the PLCNN method in the optimal control of air conditioning systems led to a significant 19.43% reduction in total monthly energy consumption. In conclusion, the proposed method offers a promising alternative to traditional approaches to forecasting and provides a solution to the common challenges encountered in traditional prediction tasks.

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Shaker, H. R., Mortensen, L. K., Søndergaard, H. a. N.
Final Project Report: Proactive and Predictive Maintenance of District Heating Systems.
University of Southern Denmark 2024

In this project, we addressed the challenge of inefficient maintenance practices in district heating systems. We developed a toolset for data validation, fault and anomaly prediction, detection, and diagnosis. Our solution, leveraging existing infrastructure, enables proactive maintenance, optimizing asset performance management and planning.

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Cheng, Y., Wen, R., Wang, Y., Sun, X., Jiang, S., Chen, Z.*, et al.*
The hidden factor in COVID-19 rehabilitation: how does the microenvironment in mobile cabin hospitals impact patient recovery? An observational study.
Therapeutic Advances in Infectious Disease, Vol. **11**, (2024)

Backgrounds:Existing studies on the treatment of emergency infectious diseases have primarily focused on the pathogen and the human immune system. However, human health is intricately connected to environmental factors, and this interaction becomes particularly during large-scale public health emergencies. Few studies have examined the impact of spatial differences in the microenvironment on the rehabilitation rate of patients with the Omicron variant infection.Objective:This study employs causal inference statistical methods and spatial analysis to investigate how the hospital microenvironment affects the rehabilitation of COVID-19 patients in a mobile cabin hospital, so as to provide a scientific basis for the spatial arrangement of patients in mobile cabin hospitals.Design:Observational study.Methods:This study used the clinical information of 6291 patients admitted in a mobile cabin hospital in Shanghai, from April 9 to May 9, 2022, during the pandemic. Exploratory spatial data analysis and fixed-effects regression analysis were conducted to understand whether the microenvironment around the patients? beds in the cabin impacted their rehabilitation.Results:The results indicate that the rehabilitation condition of patients is affected by spatial differences of microenvironment. Both the mean and minimum CT values of the surrounding patients show a significant positive correlation with the rehabilitation of patients. The further the distance from the vent is, the more the rehabilitation speed of the patients is affected by the CT values of the surrounding patients.Conclusion:These findings offer valuable insights for bed allocation, patients? stratification and management, and ventilation management in the mobile cabin hospitals during public health emergencies.

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Yüce, B. E., Kalay, O. C., Karpat, F., Alemdar, A., Temel, Ş. G., Dilektaşlı, A. G.*, et al.*
Investigation of infectious droplet dispersion in a hospital examination room cooled by split-type air conditioner.
Journal of Environmental Health Science and Engineering, Vol. **22** n°(2), (2024), 471-482 p.

The novel coronavirus (SARS-CoV-2) outbreak has spread worldwide, and the World Health Organization (WHO) declared a global pandemic in March 2020. The transmission mechanism of SARS-CoV-2 in indoor environments has begun to be investigated in all aspects. In this regard, many numerical studies on social distancing and the protection of surgical masks against infection risk have neglected the evaporation of the particles. Meanwhile, a 1.83 m (6 feet) social distancing rule has been recommended to reduce the infection risk. However, it should be noted that most of the studies were conducted in static air conditions. Air movement in indoor environments is chaotic, and it is not easy to track all droplets in a ventilated room experimentally. Computational Fluid Dynamics (CFD) enables the tracking of all particles in a ventilated environment. This study numerically investigated the airborne transmission of infectious droplets in a hospital examination room cooled by a split-type air conditioner with the CFD method. Different inlet velocities (1, 2, 3 m/s) were considered and investigated separately. Besides, the hospital examination room is a model of one of the Bursa Uludag University Hospital examination rooms. The patient, doctor, and some furniture are modeled in the room. Particle diameters considered ranged from 2 to 2000 µm. The evaporation of the droplets is not neglected, and the predictions of particle tracks are shown. As a result, locations with a high infection risk were identified, and the findings that could guide the design/redesign of the hospital examination rooms were evaluated.

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Daungsupawong, H., Wiwanitkit, V.
Managing SARS-CoV-2 transmission risk in workplace COVID-19 outbreaks. Correspondence.
Annals of Work Exposures and Health, (2024)

Dear Editor,We would like to comment on the publication “Managing SARS-CoV-2 transmission risk in workplace COVID-19 outbreaks. (Sandys et al. 2024).” This study sought to investigate the use of risk management measures (RMMs) in non-healthcare settings, emphasizing the practical obstacles to their adoption. In order to evaluate the efficacy of RMMs and workplace practices, data collection comprised of site

visits and conversations with safety officers. Carbon dioxide (CO2) levels were measured over an extended length of time in specific populated locations in order to evaluate the efficacy of ventilation systems. The outcomes showed that RMMs might be effectively used for things like mask use, telework policies, and hand hygiene procedures. Nonetheless, difficulties preserving physical distance and enhancing ventilation at work point to possible areas for development.

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Woodward D. Gardiner, B. M. D., Joseph V. Puthussery, Dishit P. Ghumra, Benjamin Sumlin,Thomas P. Cirrito, Jim E. Shapiro, David L. Shuler, Rajan K. Chakrabarty, Carla M. Yuede, John R. Cirrito.
Nanobody-based electrochemical biosensor platform for rapid detection of aerosolized pathogens.
BREATHE Matchmaking Webinars. 2024

A nanobody, raised in llamas, is covalently bound to the working electrode to concentrate the target pathogen near the surface. The electrode uses square wave voltammetry to measure oxidation of tyrosine amino acids. When pulsed with a voltage, tyrosine amino acids within the entire viral particle are oxidized which releases electrons that the electrode detects as current. The amount of current is proportional to the amount of target bound to the surface. The electrode is coated with albumin to block non-specific signal. Each measurement takes under 20 seconds with instant readout. The biosensor is being deployed in an air quality monitor for indoor detection of airborne pathogens in real-time and a breathalyzer for differential diagnosis of respiratory illness in 60 seconds.

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Wang, C., Zhao, Z., Wang, B., Cui, M.
Optimal fresh-air utilization strategy based on isocost Line: Adaptability analysis for constant temperature and humidity air-conditioning system.
Sustainable Energy Technologies and Assessments, Vol. **72**, (2024)

Reducing building operational energy consumption is important for achieving carbon peaking and carbon neutrality. The energy consumption of constant temperature and humidity air-conditioning systems is high owing to the need for strict temperature and humidity control. To maintain working efficiency or meet relative pressure differential requirements, a significant amount of fresh air must be introduced. In our previous study, an optimal fresh air utilization strategy for all conditions was developed for cost savings (including energy, CO2 emissions, and monetary costs) by considering different air-handling process costs. In this paper, the dynamic chiller station performances are considered to exploit the cost-saving potential for the developed strategy, and the cost-saving performance analyses are investigated under different application scenarios including weather, internal load, and system performances by simulation in a constant temperature and humidity air-conditioning system. The test results show that the optimal fresh air utilization strategy can realize cost-effectiveness in all scenarios, and achieve 0.77%–49.03% annual primary energy saving under a wide range of internal load variations. Optimizing the supply air state and selecting the appropriate air-handling process cost value can further unlock energy-saving potential and reduce application costs.

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Anagnostopoulos, F., Schneider, M.
Overview of Infection Control Since the Emergence of COVID-19 and Other Emerging/Re-emerging Diseases.
In: Infection Control in the Dental Office in the Era of COVID-19. Springer Nature Switzerland; 2024. 1-9 p.

Infection control is essential to provide the best oral health care to our patients in a safe environment. With the emergence of coronavirus disease (COVID-19), proper infection control in a dental setting is more necessary than ever. COVID-19 is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2); the virus can propagate by small liquid particles when the infected person

coughs, sneezes, speaks, or breathes. The particles can be larger respiratory droplets or smaller aerosols. Dental professionals are at risk since they use equipment that produces aerosol and work close to the patients' nasal and oropharyngeal regions. Consequently, the patients' oral fluids and contamination on dental unit surfaces, dental materials, and instruments could spread the infection to the dental team and patients. The risk of transmission in the dental office can be reduced by having in place well-planned infection control systems together with the proper use of personal protective equipment (PPE), adequate air exchange of clinic rooms, proper instrument sterilization, and surface disinfecting procedures.

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Xing, C., Ai, Z., Mak, C. M., Wong, H. M.
Performance evaluation of high-volume evacuation for removing droplets during dental treatment.
Building Simulation, (2024)

The high-volume evacuation (HVE) is commonly employed as a primary source control measure for removing splatter emitted from mouth during dental treatments, but there is still a lack of comprehensive understanding of its efficiency. Based on our previous experiments on the emission characteristics during dental treatments, this study employed computational fluid dynamics (CFD) simulations to investigate the impact of emission parameters (droplet size, emission velocity, emission angle), HVE usage methods (distance between HVE and the droplet release source), and HVE suction flow rates on its removal efficiency. The effect of HVE on fallow time (FT) was also examined. Cumulative removal efficiency that accurately reflected the HVE effect was proposed as an evaluation index. It was found that emission velocity and distance between HVE and the source were key factors determining cumulative removal efficiency. When the distance was 4 cm, the cumulative removal efficiencies for low-velocity (0.8 m/s), medium-velocity (3.4 m/s), and high-velocity droplets (6.0 m/s) were approximately 97.9%, 73.6%, and 58.0%, respectively. For high-velocity droplets at 6.0 m/s, decreasing the distance from 4 cm to 2 cm and 1 cm increased the cumulative removal efficiency from 58.0% to 76.7% and 100%. This study was expected to enhance the understanding of HVE performance and provide information on its usage method. It also indicated the need for developing advanced control measures that could have high efficiency in removing both low-velocity and high-velocity droplets.

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More, W. C. D. H., Yadava, B. D. R. K., Garg, C. D. N., Sahran, L. C. D. D., Dahiya, M. D. S., Parankusam, S. L. D. K. C.
The Planning Premises for A Tuberculosis Centre.
International Journal For Multidisciplinary Research, Vol. **6** n°(2), (2024)

The aim of this study is to plan the premises for the establishment of a Tuberculosis Centre. The objectives include studying the layout of an existing Tuberculosis Centre, investigating available Guidelines, and developing the planning premises for a Tuberculosis Centre with a specific focus on the Waiting area, Out-patient Unit, Ward, Isolation room, and the inclusion of a Respiratory Rehabilitation Unit.

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Mikszewski, A.
Quantitative Risk Assessment for Airborne Transmission of Disease.
Queensland University of Technology. Thèse 2024

This project made important contributions to the science of modeling airborne transmission of respiratory tract infection, including methods and applications useful to public health and building design. The novelty of the work included combining airborne transmission risk during close contact with the infection risk from breathing shared indoor air at the room scale. Original estimates of the infectious airborne emission rate were

developed for nine different pathogens for different respiratory activities, such that airborne contagiousness can be compared. Further research is needed to incorporate the developed methods into broader epidemiological models for cost-benefit analysis of ventilation improvements at scale.

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Carla M. Yuede, D. P. G., Nishit J. Shetty, Kevin R. Mcbrearty, Joseph V. Puthussery, Benjamin J. Sumlin, Woodrow D. Gardiner, Brookelyn M. Doherty, Jordan P. Magrecki, Jane A. O'halloran,, Rachel M. Presti, T. L. B., Adrianus C.M. Boon, Tom Cirrito, Dave Shuler, Jim Shapiro, John R. Cirrito and Rajan K. Chakrabarty.
Rapid direct detection of SARS-CoV-2 aerosols in exhaled breathfor point of entry screening.
BREATHE Matchmaking Webinars. 2024

The testing platform integrates a Breath Aerosol Collection device and a Micro-immunoelectrode (MIE) biosensor. The following steps describe the working of our testing platform as a clinical diagnostic tool for detecting SARS-CoV-2

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Papadakis, A., Chochlakis, D., Koufakis, E., Carayanni, V., Psaroulaki, A.
Recreational Water Safety in Hotels: Lessons from the COVID-19 Pandemic and the Way Forward for a Safe Aquatic Environment.
Tourism and Hospitality, Vol. **5** n°(4), (2024), 1167-1181 p.

The recreational waters of hotels are widely used by locals and travelers all around the world, and this impacts public health. In this regard, the WHO frequently offers recommendations—especially during the COVID-19 era—that operators and managers of public pools, hot tubs, or splash pads should continue to follow. This study aims to evaluate the microbiological results of COVID-19 sanitation protocols in recreational waters in hotels during the summer periods post-COVID-19 (2020–2022) and compare them with those pre-COVID-19 (2019). Of the samples tested during the pre-pandemic period, less than 1/5 were positive for total coliforms, common aerobic bacteria, and P. aeruginosa, while less than 3% of the samples tested were positive for E. coli. During the pandemic years, the percentages dropped by half for total coliforms, common aerobic bacteria, and E. coli, while only the percentage for P. aeruginosa remained the same. The relative risk (RR) for the presence of P. aeruginosa in recreational waters was greatly affected by chlorine levels, pH values, and water temperature. Our results elucidate the impact of sanitation protocols on the safety of recreational waters in hotels during public health crises. Moreover, the challenges operators face in maintaining long-term implementation of these protocols are highlighted, which in turn dictates the appropriate choice of preventive and applicable measures to ensure health and safety.

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Lu, Y., Oladokun, M., Lin, Z.
Reducing the exposure risk in hospital wards by applying stratum ventilation system.
Building and Environment, Vol. **183**, (2020)

In order to improve the ventilation design for hospital wards and protect the healthcare workers from respiratory infections, stratum ventilation is proposed to reduce the exposure risk. A numerical (CFD) approach is applied to investigate contaminant distribution in a two-bed hospital ward with two patients and one healthcare worker under stratum ventilation, mixing ventilation, downward ventilation and displacement ventilation. Tracer gas (CO2) is also applied to simulate the exhaled and coughed contaminants by patients. The patients are in positions of lying or sitting in bed. The contaminant concentration distributions and contaminant removal effectiveness under the different air distributions are compared. The results show that under stratum ventilation, with two patients breathing, the contaminant concentration in the breathing zone (1.3–1.7 m above the floor) is comparably lower, the contaminant removal effectiveness is relatively higher.

The contaminant concentration at different moments after a patient's cough is also compared. The results show that the coughed contaminant is diluted quickly under stratum ventilation, and the high concentration spot is substantially reduced. The results show that stratum ventilation minimises the exposure risk of healthcare workers in hospital wards.

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Kiil, M., Mikola, A., Võsa, K.-V., Simson, R., Kurnitski, J.
Ventilation effectiveness and incomplete mixing in air distribution design for airborne transmission.
Building and Environment, Vol. **267**, (2025)

How ventilation should be arranged to be effective at reasonable air change rates is one key question as ventilation criteria and standard airborne disease transmission models are based on the well-mixed assumption, but air distribution patterns lead to non-uniform spatial concentrations. In this study a new method for ventilation effectiveness application in ventilation design for airborne transmission was developed and tested with tracer gas measurements in 22 rooms. Contrary to existing ventilation effectiveness values measured with distributed source, the developed method uses a couple of point source locations corresponding to an infector to quantify infection risk for each occupant. Novelty of the method is new ventilation effectiveness indicator that makes it possible to describe the effect of spatial variation of concentration and risk with single parameter. Quanta were used as input data to calculate the ventilation rate supplied by air distribution system corresponding to a specified risk level, but the differences between studied cases do not significantly depend on the quanta values. Application of the method to measured rooms showed that simple ventilation effectiveness calculation from average concentration at the breathing height, not requiring quanta data, provided lower ventilation effectiveness and higher ventilation rate in all cases. In many cases the difference in required ventilation rates was only a few percent, but in some large spaces it exceeded 10% with maximum of 39% in large open plan office with high concentration differences. Measured ventilation effectiveness values ranging from 0.5 to 1.4 indicate a substantial improvement potential in many cases.

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Mazri, M., Ferhati, K.
What makes housing more vulnerable to pandemics? A Review of Post-Covid19 literature.
E3S Web Conf., Vol. **585**, (2024)

While the COVID-19 pandemic has significantly heightened awareness of vulnerabilities within residential buildings, this study, applying a systematic literature review methodology, aims to identify the primary factors contributing to vulnerability in housing. Focusing on potential factors that impact the transmission of SARS-CoV-2, a comprehensive search conducted on the Scopus database and other citation sources was explored using the PRISMA-ScR Checklist. The selected literature was analyzed to extract a set of vulnerability indicators, categorized into three dimensions of vulnerability: exposure (E), sensitivity (S), and adaptability (A). The first dimension involves external factors that affect housing quality and can be identified at the neighborhood scale, such as urban density, connectivity, land use, and environmental quality. Indicators measuring occupancy, closeness features, and contagious materials inside the dwelling concern the sensitive dimension, as they are related to indoor space characteristics that are likely to facilitate virus transmission. The adaptability-based vulnerability expresses the adaptive capacity of housing to overcome the pandemic, emphasizing layout design and surrounding spaces for better prevention, human comfort, and wellbeing. These vulnerability indicators underscore the importance of establishing building epidemic prevention standards and integrating epidemic prevention into the architectural planning and design phases.

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