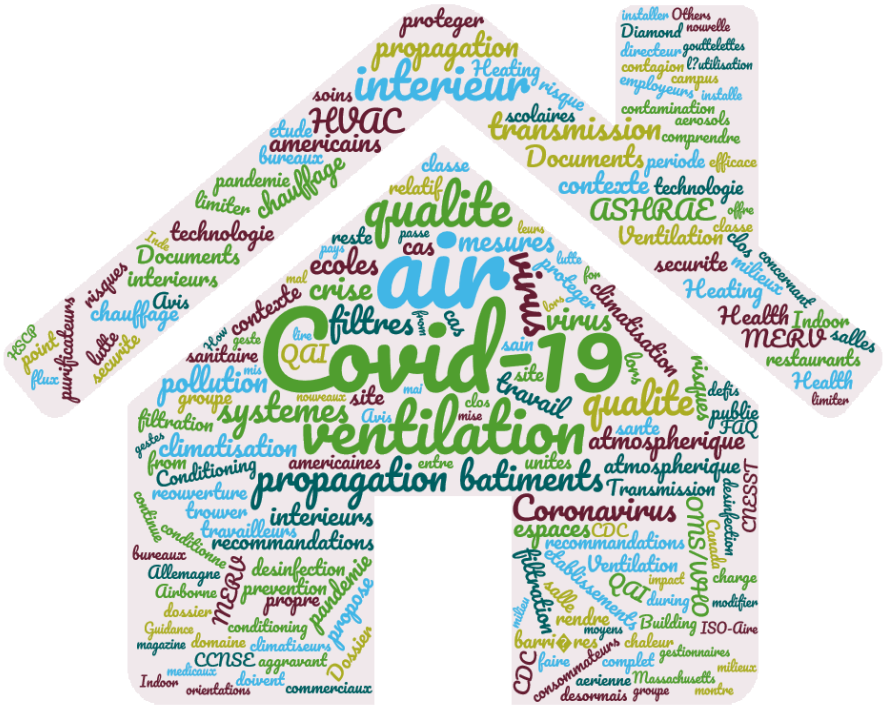

Rapport de veille n° 36

Aéraulique et COVID-19

19/01/2022

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Google Scholar et WoS

Toosty, N. T., Hagishima, A., Bari, W., Zaki, S. A.
Behavioural changes in air-conditioner use owing to the COVID-19 movement control order in Malaysia.
Sustainable production and consumption, Vol. **30**, (2022), pp. 608-622

Remote work (working from home) became a norm rather than an exception for the global workforce during the COVID-19 pandemic, influencing every facet of life in both positive and negative ways. The stringent action of the Malaysian government in enacting the Movement Control Order (MCO) motivated the investigation of its impact on the energy consumption behaviour of working people regarding air-conditioner (AC) use. To this end, this study conducted a cross-sectional survey through an online platform. An ordinal logistic regression model (ORL) was used to analyse the collected data of 1873 respondents to determine the factors influencing the ordinal variable of interest, AC-usage behaviour during remote work. Next, the variable with unordered categories, the MCO-induced change in AC-usage behaviour, was analysed using a multinomial regression model (MLT) to identify the potential determinants. Finally, a reason analysis unveiled aspects behind the transition in AC use during remote work. This study identified stopping AC use during remote work despite using it at the office before the MCO period as the most significant change in AC-usage behaviour due to MCO. This change was frequently adopted by people with medium-level incomes and high electricity bills. By contrast, participants unfamiliar with their electricity bill were most likely to start AC use during remote work, although they did not use it before the MCO. Participants working remotely in the communal spaces of their houses preferred to stop using ACs during MCO compared to private room users. Furthermore, age group and ethnicity significantly influenced AC-usage behaviour in remote work and changes in such demeanours. These findings recommend policy interventions to expedite limited AC use for a sustainable energy sector, even during future climatic emergencies .

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Breshears, L. E., Nguyen, B. T., Mata Robles, S., Wu, L., Yoon, J.-Y.
Biosensor detection of airborne respiratory viruses such as SARS-CoV-2.
SLAS Technology, (2022)

Airborne SARS-CoV-2 transmission represents a significant route for possible human infection that is not yet fully understood. Viruses in droplets and aerosols are difficult to detect because they are typically present in low amounts. In addition, the current techniques used, such as RT-PCR and virus culturing, require large amounts of time to get results. Biosensor technology can provide rapid, handheld, and point-of-care systems that can identify virus presence quickly and accurately. This paper reviews the background of airborne virus transmission and the characteristics of SARS-CoV-2, its relative risk for transmission even at distances greater than the currently suggested 6 feet (or 2 m) physical distancing. Publications on biosensor technology that may be applied to the detection of airborne SARS-CoV-2 and other respiratory viruses are also summarized. Based on the current research we believe that there is a pressing need for continued research into handheld and rapid methods for sensitive collection and detection of airborne viruses. We propose a paper-based microfluidic chip and immunofluorescence assay as one method that could be investigated as a low-cost and portable option.

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Houssin, D.
Caractéristiques et développements inattendus de la pandémie de Covid-19.
ADSP, Vol. **116** n°(4), (2021), pp. 13-15

Plan
-Des surprises en matière de transmission du virus
-La remise à l'honneur des méthodes non pharmacologiques de réduction du risque de transmission du virus
-La mise au point rapide de plusieurs vaccins efficaces, sûrs et fondés sur des technologies nouvelles, en contraste avec l'absence de découverte d'un traitement médicamenteux simple
-Un carambolage international et européen, compensé par quelques heureuses initiatives
-**Au-delà de ses conséquences sanitaires, un impact massif de la pandémie de Covid-19 dans de nombreux secteurs**

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Han, T., Park, H., Jeong, Y., Lee, J., Shon, E., Park, M.-S.*, et al.*
COVID-19 Cluster Linked to Aerosol Transmission of SARS-CoV-2 via Floor Drains.
The Journal of Infectious Diseases, (2022), 7 p.

Recently, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission through exposure to aerosols has been suggested. Therefore, we investigated the possibility of aerosol SARS-CoV-2 transmission within an apartment complex where residents reported testing positive for SARS-CoV-2 despite having no direct contact with other SARS-CoV-2–infected people.Information on symptom onset and exposure history of the patients was collected by global positioning system (GPS) tracking to investigate possible points of contact or spread. Samples collected from patients and from various areas of the complex were analyzed using RNA sequencing. Phylogenetic analysis was also performed.Of 19 people with confirmed SARS-CoV-2 infection, 5 reported no direct contact with other residents and were from apartments in the same vertical line. Eight environmental samples tested positive for the virus. Phylogenetic analyses revealed that 3 of the positive cases and 1 environmental sample belonged to the B.1.497 lineage. Additionally, 3 clinical specimens and 1 environmental sample from each floor of the complex had the same amino acid substitution in the ORF1ab region.SARS-CoV-2 transmission possibly occurs between different floors of an apartment building through aerosol transmission via nonfunctioning drain traps.

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Aliero, M. S., Pasha, M. F., Toosi, A. N., Ghani, I.
The COVID-19 impact on air condition usage: a shift towards residential energy saving.
Environmental science and pollution research international, (2022)

The enforcement of the Movement Control Order to curtail the spread of COVID-19 has affected home energy consumption, especially HVAC systems. Occupancy detection and estimation have been recognized as key contributors to improving building energy efficiency. Several solutions have been proposed for the past decade to improve the precision performance of occupancy detection and estimation in the building. Environmental sensing is one of the practical solutions to detect and estimate occupants in the building during uncertain behavior. However, the literature reveals that the performance of environmental sensing is relatively poor due to the poor quality of the training dataset used in the model. This study proposed a smart sensing framework that combined camera-based and environmental sensing approaches using supervised learning to gather standard and robust datasets related to indoor occupancy that can be used for cross-validation of different machine learning algorithms in formal research. The proposed solution is tested in the living room with a prototype system integrated with various sensors using a random forest regressor, although other techniques could be easily integrated within the proposed framework. The primary implication of this study is to predict the room occupation through the use of sensors providing inputs into a model to lower energy consumption. The results indicate that the proposed solution can obtain data, process, and predict occupant presence and number with 99.3% accuracy. Additionally, to demonstrate the impact of occupant number in energy saving, one room with two zones is modeled each zone with air condition with

different thermostat controller. The first zone uses IoFClime and the second zone uses modified IoFClime using a design-builder. The simulation is conducted using EnergyPlus software with the random simulation of 10 occupants and local climate data under three scenarios. The Fanger model's thermal comfort analysis shows that up to 50% and 25% energy can be saved under the first and third scenarios.

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Fukuda, K., Yoshida, M., Noto, K., Kitabayashi, K., Katsushima, S., Sonehara, H.*, et al.*
Detection of Suspended SARS-CoV-2 in Indoor Air Using an Electrostatic Sampler.
Research Square, (2022), 11 p.

A prototype virus sampler using electrostatic precipitation has been developed to investigate aerosol infection by SARS-CoV-2. The sampler consists of a discharge electrode placed inside a vial, and a thin layer of viral lysis buffer at the bottom, working as a collection electrode. The sampler was operated with the sampling air flow rate of 40 L/min. Collection efficiency of the sampler is about 80% for 25nm to 5.0µm diameter particles. We sampled the air of a food court of a commercial facility, a connecting corridor of a clouded train station, and two office rooms (A and B) in September 2021, just after the 5 th peak of COVID-19 in Japan. The analysis using a RT-qPCR detected the virus RNA in the air of the office A, B and the food court. Estimated concentration of the virus in the air determined by calibration curve was 2.0 x 10 ^{2} , 7.8 x 10 ^{2} , and 0.6 - 2.4 x 10 ^{2} copies/m ^{3} , in the office A, B, and the food court, respectively. These results indicate that the sampler using electrostatic precipitation can detect SARS-CoV-2 in indoor air. It could be developed as a risk assessment method for aerosol infection.

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Silva, P. G. D., Gonçalves, J., Lopes, A. I. B., Esteves, N. A., Bamba, G. E. E., Nascimento, M. S. J.*, et al.*
Evidence of Air and Surface Contamination with SARS-CoV-2 in a Major Hospital in Portugal.
International Journal of Environmental Research and Public Health, Vol. **19** n°(1), (2022), 13 p.

As the third wave of the COVID-19 pandemic hit Portugal, it forced the country to reintroduce lockdown measures due to hospitals reaching their full capacities. Under these circumstances, environmental contamination by SARS-CoV-2 in different areas of one of Portugal's major Hospitals was assessed between 21 January and 11 February 2021. Air samples (n = 44) were collected from eleven different areas of the Hospital (four COVID-19 and seven non-COVID-19 areas) using Coriolis® µ and Coriolis® Compact cyclone air sampling devices. Surface sampling was also performed (n = 17) on four areas (one COVID-19 and three non-COVID-19 areas). RNA extraction followed by a one-step RT-qPCR adapted for quantitative purposes were performed. Of the 44 air samples, two were positive for SARS-CoV-2 RNA (6575 copies/m3 and 6662.5 copies/m3, respectively). Of the 17 surface samples, three were positive for SARS-CoV-2 RNA (200.6 copies/cm2, 179.2 copies/cm2, and 201.7 copies/cm2, respectively). SARS-CoV-2 environmental contamination was found both in air and on surfaces in both COVID-19 and non-COVID-19 areas. Moreover, our results suggest that longer collection sessions are needed to detect point contaminations. This reinforces the need to remain cautious at all times, not only when in close contact with infected individuals. Hand hygiene and other standard transmission-prevention guidelines should be continuously followed to avoid nosocomial COVID-19.

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Saccani, C., Guzzini, A., Vocale, C., Gori, D., Pellegrini, M., Fantini, M. P.*, et al.*
Experimental testing of air filter efficiency against the SARS-CoV-2 virus: The role of droplet and airborne transmission.
Building and environment, Vol. **210**, (2022)

Verifying the capacity of different types of air filters to stop the propagation of the SARS-CoV-2 virus has become a strategic element to contain viral spreading in enclosed spaces. This paper shows the results of

experimental tests about the capacity of different commercial filter grades to stop SARS-CoV-2 propagation using inactivated virions. In the first test, the obtained results showed that the F8 filter blocks SARS-CoV-2 propagation if it encounters a flow devoid of liquid phase, i.e., a biphasic flow that can wet the filtering material. On the contrary, as shown in the second test, the SARS-CoV-2 virus propagates through the F8 filter if the droplet content in the air flow is enough to wet it. In these operational conditions, i.e., when the filter is wet by a flow with a high droplet content, the absolute H14 filter was also shown to fail to stop the transmission of the SARS-CoV-2 virus. Lastly, in the third test, the viral load was shown to be stopped when the pathway of the infected droplet is blocked.

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Riediker, M., Briceno-Ayala, L., Ichihara, G., Albani, D., Poffet, D., Tsai, D.-H.*, et al.*
Higher viral load and infectivity increase risk of aerosol transmission for Delta and Omicron variants of SARS-CoV-2.
Swiss Medical Weekly, n°(1), (2022)

BACKGROUND: Airborne transmission of SARS-CoV-2 is an important route of infection. For the wildtype (WT) only a small proportion of those infected emitted large quantities of the virus. The currently prevalent variants of concern, Delta (B1.617.2) and Omicron (B.1.1.529), are characterized by higher viral loads and a lower minimal infective dose compared to the WT. We aimed to describe the resulting distribution of airborne viral emissions and to reassess the risk estimates for public settings given the higher viral load and infectivity.
METHOD: We reran the Monte Carlo modelling to estimate viral emissions in the fine aerosol size range using available viral load data. We also updated our tool to simulate indoor airborne transmission of SARS-CoV-2 by including a CO2 calculator and recirculating air cleaning devices. We also assessed the consequences of the lower critical dose on the infection risk in public settings with different protection strategies.
RESULTS: Our modelling suggests that a much larger proportion of individuals infected with the new variants are high, very high or super-emitters of airborne viruses: for the WT, one in 1,000 infected was a super-emitter; for Delta one in 30; and for Omicron one in 20 or one in 10, depending on the viral load estimate used. Testing of the effectiveness of protective strategies in view of the lower critical dose suggests that surgical masks are no longer sufficient in most public settings, while correctly fitted FFP2 respirators still provide sufficient protection, except in high aerosol producing situations such as singing or shouting.
DISCUSSION: From an aerosol transmission perspective, the shift towards a larger proportion of very high emitting individuals, together with the strongly reduced critical dose, seem to be two important drivers of the aerosol risk, and are likely contributing to the observed rapid spread of the Delta and Omicron variants of concern. Reducing contacts, always wearing well-fitted FFP2 respirators when indoors, using ventilation and other methods to reduce airborne virus concentrations, and avoiding situations with loud voices seem critical to limiting these latest waves of the COVID-19 pandemic.

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Rivas, E., Santiago, J. L., Martin, F., Martilli, A.
Impact of natural ventilation on exposure to SARS-CoV 2 in indoor/semi-indoor terraces using CO2 concentrations as a proxy.
Journal of Building Engineering, Vol. **46**, (2022)

Nowadays, it is necessary a better airborne transmission understanding of respiratory diseases in shared indoor and semi-indoor environments with natural ventilation in order to adopt effective people's health protection measures. The aim of this work is to evaluate the relative exposure to SARS-CoV 2 in a set of virtual scenarios representing enclosed and semi-enclosed terraces under different outdoor meteorological conditions. For this purpose, indoor CO2 concentration is used as a proxy for the risk assessment. Airflow and people exhaled CO2 in different scenarios are simulated through Computational Fluid Dynamics (CFD) modelling with Unsteady ReynoldsAveraged Navier-Stokes (URANS) approach. Both spatial average

concentrations and local concentrations are analyzed. In general, spatial average concentrations decrease as ventilation increases, however, depending on the people arrangement inside the terrace, spatial average concentrations and local concentrations can be very different. Therefore, for assessing the relative exposure to SARS-CoV 2 it is necessary to consider the indoor flow patterns between infectors and susceptibles. This research provides detailed information about CO2 dispersion in enclosed/semienclosed scenarios, which can be very useful for reducing the transmission risk through better natural ventilation designs and improving the classic risk models since it allows to check their hypotheses in real-world scenarios. Although CFD ventilation studies in indoor/semi-indoor environments have been already addressed in the literature, this research is focused on restaurant terraces, scenarios scarcely investigated. Likewise, one of the novelties of this study is to take into account the outdoor meteorological conditions to appropriately simulate natural ventilation.

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Boyer, C. B., Rumpler, E., Kissler, S. M., Lipsitch, M.
Infectious disease dynamics and restrictions on social gathering size.
medRxiv, (2022)

Social gatherings can be an important locus of transmission for many pathogens including SARS-CoV-2. During an outbreak, restricting the size of these gatherings is one of several non-pharmaceutical interventions available to policy-makers to reduce transmission. Often these restrictions take the form of prohibitions on gatherings above a certain size. While it is generally agreed that such restrictions reduce contacts, the specific size threshold separating “allowed” from “prohibited” gatherings often does not have a clear scientific basis, which leads to dramatic differences in guidance across location and time. Building on the observation that gathering size distributions are often heavy-tailed, we develop a theoretical model of transmission during gatherings and their contribution to general disease dynamics. We find that a key, but often overlooked, determinant of the optimal threshold is the distribution of gathering sizes. Using data on pre-pandemic contact patterns from several sources as well as empirical estimates of transmission parameters for SARS-CoV-2, we apply our model to better understand relationship between restriction threshold and reduction in cases. We find that, under reasonable transmission parameter ranges, restrictions may have to be set quite low to have any demonstrable effect on cases due to relative frequency of smaller gatherings. We compare our conceptual model with observed changes in reported contacts during lockdown in March of 2020.

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Honaker, M., Kidder, C., Luke, B., Mummadi, S., Roggekamp, H.
K-12 Classroom Ventilation for Slowed COVID-19 Transmission.
University of Michigan, ME 450 : Design and Manufacturing III, Team 9.1 2021. 77 p.

The COVID-19 pandemic continues to impact the lives of many people with over 15 million cases in the last 6 months. Cases are rising and disproportionately affecting low-income communities. A lack of proper ventilation contributes to the spread of the virus in these communities. Poorly funded K-12 schools in the U.S. have shown high transmission rates relative to organizations that can afford adequate ventilation. The existing solution space for ventilation lacks an option that is reliable and cost-effective for classrooms. A solution that fills these gaps could decrease the transmission of COVID-19 in poorly funded K-12 schools.

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Squinazi, F., Lepelletier, D.
Les mesures barrières : de nouvelles règles de vie ?
ADSP, Vol. **116** n°(4), (2021), pp. 29-32

Face à un virus pandémique à tropisme respiratoire, le HCSP a très rapidement défini une doctrine de prévention sanitaire. Ces mesures de santé publique doivent être appliquées au quotidien dans la vie des

citoyens, même en dehors de tout symptôme d'infection, et déclinées dans tous les lieux de vie. Elles restent encore d'actualité…

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Nagy, A., Horváth, A., Farkas, Á., Füri, P., Erdélyi, T., Madas, B. G.*, et al.*
Modeling of nursing care-associated airborne transmission of SARS-CoV-2 in a real-world hospital setting.
GeroScience, (2022)

Respiratory transmission of SARS-CoV-2 from one older patient to another by airborne mechanisms in hospital and nursing home settings represents an important health challenge during the COVID-19 pandemic. However, the factors that influence the concentration of respiratory droplets and aerosols that potentially contribute to hospital- and nursing care-associated transmission of SARS-CoV-2 are not well understood. To assess the effect of health care professional (HCP) and patient activity on size and concentration of airborne particles, an optical particle counter was placed (for 24 h) in the head position of an empty bed in the hospital room of a patient admitted from the nursing home with confirmed COVID-19. The type and duration of the activity, as well as the number of HCPs providing patient care, were recorded. Concentration changes associated with specific activities were determined, and airway deposition modeling was performed using these data. Thirty-one activities were recorded, and six representative ones were selected for deposition modeling, including patient's activities (coughing, movements, etc.), diagnostic and therapeutic interventions (e.g., diagnostic tests and drug administration), as well as nursing patient care (e.g., bedding and hygiene). The increase in particle concentration of all sizes was sensitive to the type of activity. Increases in supermicron particle concentration were associated with the number of HCPs ($r = 0.66$; $p < 0.05$) and the duration of activity ($r = 0.82$; $p < 0.05$), while submicron particles increased with all activities, mainly during the daytime. Based on simulations, the number of particles deposited in unit time was the highest in the acinar region, while deposition density rate (number/cm2/min) was the highest in the upper airways. In conclusion, even short periods of HCP-patient interaction and minimal patient activity in a hospital room or nursing home bedroom may significantly increase the concentration of submicron particles mainly depositing in the acinar regions, while mainly nursing activities increase the concentration of supermicron particles depositing in larger airways of the adjacent bed patient. Our data emphasize the need for effective interventions to limit hospital- and nursing care-associated transmission of SARS-CoV-2 and other respiratory pathogens (including viral pathogens, such as rhinoviruses, respiratory syncytial virus, influenza virus, parainfluenza virus and adenoviruses, and bacterial and fungal pathogens).

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Stefano, J. S., Guterres E Silva, L. R., Rocha, R. G., Brazaca, L. C., Richter, E. M., Abarza Munoz, R. A.*, et al.*
New conductive filament ready-to-use for 3D-printing electrochemical (bio)sensors: Towards the detection of SARS-CoV-2.
Analytica Chimica Acta, Vol. **1191**, (2022)

The 3D printing technology has gained ground due to its wide range of applicability. The development of new conductive filaments contributes significantly to the production of improved electrochemical devices. In this context, we report a simple method to producing an efficient conductive filament, containing graphite within the polymer matrix of PLA, and applied in conjunction with 3D printing technology to generate (bio)sensors without the need for surface activation. The proposed method for producing the conductive filament consists of four steps: (i) mixing graphite and PLA in a heated reflux system; (ii) recrystallization of the composite; (iii) drying and; (iv) extrusion. The produced filament was used for the manufacture of electrochemical 3D printed sensors. The filament and sensor were characterized by physicochemical techniques, such as SEM, TGA, Raman, FTIR as well as electrochemical techniques (EIS and CV). Finally, as a proof-of-concept, the fabricated 3D-printed sensor was applied for the determination of uric acid and dopamine in synthetic urine and used as a platform for the development of a biosensor for the detection of SARS-CoV-2. The developed sensors,

without pre-treatment, provided linear ranges of 0.5-150.0 and 5.0-50.0 mu mol L-1, with low LOD values (0.07 and 0.11 mu mol L-1), for uric acid and dopamine, respectively. The developed biosensor successfully detected SARS-CoV-2 S protein, with a linear range from 5.0 to 75.0 nmol L-1 (0.38 mu g mL(-1) to 5.74 mu g mL(-1)) and LOD of 1.36 nmol L-1 (0.10 mu g mL(-1)) and sensitivity of 0.17 mu A nmol(-1) L (0.01 mu A mu g(-1) mL). Therefore, the lab-made produced and the ready-to-use conductive filament is promising and can become an alternative route for the production of different 3D electrochemical (bio)sensors and other types of conductive devices by 3D printing.

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Hoffman, J. S., Hirano, M., Panpradist, N., Breda, J., Ruth, P., Xu, Y.*, et al.*
Passively sensing SARS-CoV-2 RNA in public transit buses.
The Science of the total environment, (2022)

Affordably tracking the transmission of respiratory infectious diseases in urban transport infrastructures can inform individuals about potential exposure to diseases and guide public policymakers to prepare timely responses based on geographical transmission in different areas in the city. Towards that end, we designed and tested a method to detect SARS-CoV-2 RNA in the air filters of public buses, revealing that air filters could be used as passive fabric sensors for the detection of viral presence. We placed and retrieved filters in the existing HVAC systems of public buses to test for the presence of trapped SARS-CoV-2 RNA using phenol-chloroform extraction and RT-qPCR. SARS-CoV-2 RNA was detected in 14% (5/37) of public bus filters tested in Seattle, Washington, from August 2020 to March 2021. These results indicate that this sensing system is feasible and that, if scaled, this method could provide a unique lens into the geographically relevant transmission of SARS-CoV-2 through public transit rider vectors, pooling samples of riders over time in a passive manner without installing any additional systems on transit vehicles.

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Peng, Z., Rojas, A. L. P., Kropff, E., Bahnfleth, W., Buonanno, G., Dancer, S. J.*, et al.*
Practical Indicators for Risk of Airborne Transmission in Shared Indoor Environments and Their Application to COVID-19 Outbreaks.
Environmental science & technology, Vol. **56** n°(2), (2022), pp. 1125–1137

Some infectious diseases, including COVID-19, can undergo airborne transmission. This may happen at close proximity, but as time indoors increases, infections can occur in shared room air despite distancing. We propose two indicators of infection risk for this situation, that is, relative risk parameter (Hr) and risk parameter (H). They combine the key factors that control airborne disease transmission indoors: virus-containing aerosol generation rate, breathing flow rate, masking and its quality, ventilation and aerosol-removal rates, number of occupants, and duration of exposure. COVID-19 outbreaks show a clear trend that is consistent with airborne infection and enable recommendations to minimize transmission risk. Transmission in typical prepandemic indoor spaces is highly sensitive to mitigation efforts. Previous outbreaks of measles, influenza, and tuberculosis were also assessed. Measles outbreaks occur at much lower risk parameter values than COVID-19, while tuberculosis outbreaks are observed at higher risk parameter values. Because both diseases are accepted as airborne, the fact that COVID-19 is less contagious than measles does not rule out airborne transmission. It is important that future outbreak reports include information on masking, ventilation and aerosol-removal rates, number of occupants, and duration of exposure, to investigate airborne transmission.

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Mksoud, M., Ittermann, T., Holtfreter, B., Söhnel, A., Söhnel, C., Welk, A.*, et al.*
Prevalence of SARS-CoV-2 IgG antibodies among dental teams in Germany.
Clinical Oral Investigations, (2022), 10 p.

During the corona pandemic, dental practices temporarily closed their doors to patients except for emergency treatments. Due to the daily occupational exposure, the risk of SARS-CoV-2 transmission among dentists and their team is presumed to be higher than that in the general population. This study examined this issue among dental teams across Germany.

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Cousins, M., Patel, K., Araujo, M., Beaton, L., Scott, C., Stirling, D.*, et al.*
A qualitative analysis of dental professionals' beliefs and concerns about providing aerosol generating procedures early in the COVID-19 pandemic.
BDJ Open, Vol. **8** n°(1), (2022), 6 p.

In response to the COVID-19 pandemic, the Scottish Dental Clinical Effectiveness Programme (SDCEP) initiated a rapid review of the evidence related to the generation and mitigation of aerosols in dental practice. To support this review, a survey was distributed to better understand the provision of aerosol generating procedures (AGPs) in dentistry.

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Parhizkar, H., Dietz, L., Olsen-Martinez, A., Horve, P. F., Barnatan, L., Northcutt, D.*, et al.*
Quantifying environmental mitigation of aerosol viral load in a controlled chamber with participants diagnosed with COVID-19.
Clinical Infectious Diseases, (2022)

Several studies indicate that COVID-19 is primarily transmitted within indoor spaces. Therefore, environmental characterization of SARS-CoV-2 viral load with respect to human activity, building parameters, and environmental mitigation strategies is critical to combat disease transmission.We recruited 11 participants diagnosed with COVID-19 to individually occupy a controlled chamber and conduct specified physical activities under a range of environmental conditions; we collected human and environmental samples over a period of three days for each participant.Here we show that increased viral load, measured by lower RNA cycle threshold (CT) values, in nasal samples is associated with higher viral loads in environmental aerosols and on surfaces captured in both the near field (1.2 m) and far field (3.5 m). We also found that aerosol viral load in far field is correlated with the number of particles within the range of 1 µm -2.5 µm. Furthermore, we found that increased ventilation and filtration significantly reduced aerosol and surface viral loads, while higher relative humidity resulted in lower aerosol and higher surface viral load, consistent with an increased rate of particle deposition at higher relative humidity. Data from near field aerosol trials with high expiratory activities suggest that respiratory particles of smaller sizes (0.3 µm -1 µm) best characterize the variance of near field aerosol viral load.Our findings indicate that building operation practices such as ventilation, filtration, and humidification substantially reduce the environmental aerosol viral load, and therefore inhalation dose, and should be prioritized to improve building health and safety.

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Ohishi, T., Yamagishi, T., Kurosu, H., Kato, H., Takayama, Y., Anan, H.*, et al.*
SARS-CoV-2 delta AY. 1 variant cluster in an accommodation facility for COVID-19: Research study.
Research Square, (2022)

Background This is a case report on a cluster infection of novel severe acute respiratory syndrome coronavirus 2 delta AY.1 variant at an accommodation facility and the subsequent attempts to isolate individuals who tested positive. Methods The background that facilitated this cluster was investigated, and the conditions in which infection was established, the infection route, and the effectiveness of routine measures were evaluated. Ninety-nine staff members had been working at the accommodation facility at the time of

infection, and it was estimated that 10 members were infected with the delta AY.1 variant. Results Our results suggest that infection of staff from a patient staying overnight should be excluded. The factors contributing to the cluster infection involved short-distance conversations with individuals wearing non-woven three-layer masks moved out of position (non-woven) and gathering together with individuals wearing non-woven masks in hypoventilated conditions. Our findings also indicate that this variant is possibly airborne and can infect individuals in enclosed spaces with poor ventilation, even when either infected or exposed individuals wear non-woven masks. Conclusions The routine maintenance of systems established for the detection of infections and prompt and appropriate preventive measures following the identification of positive individuals will help prevent further cluster infections.

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Moldabayeva, Z. S., Schmidt, P., Seitbattalov, Z. Y., Amankeldinov, T. A.
Simulation Of An Intelligent Detection System Virus SARS-CoV-2 In Enclosed Spaces.
In: 2021 16th International Conference on Electronics Computer and Computation (ICECCO). 2021. pp. 1-5.

During the COVID-19 pandemic, methods to determine the presence of coronavirus are very relevant. In this article, a new method has been developed to detect the presence of the SARS-CoV-2 virus in the air. The article analyzes in detail the signs indicating favorable conditions for the spread of the virus. The influence of changes in temperature, humidity, the presence of particles in the air, the level of CO2 and the ventilation of the room on the probability of infection with the virus is considered.Based on the studied parameters, a model was built. It allows to detect the probability of the threat of the spread of the virus. The model was implemented as a fuzzy controller in the Matlab environment. The studied parameters were taken as input parameters for constructing the model. The output parameter was the detector value indicating the presence or absence of a virus in the air.Thus, the built system allows detecting situations in which coronavirus infection is most likely. The system makes a conclusion about the degree of risk of the spread of the virus and, in case of danger, informs about the need for disinfection actions. The use of this system will reduce the cost of processing enclosed spaces, since it will not be carried out according to schedule, but in the case of a system signal.

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Wilson, A. M., Sleeth, D. K., Schaefer, C., Jones, R. M.
Transmission of Respiratory Viral Diseases to Health Care Workers: COVID-19 as an Example.
Annual Review of Public Health, (2022)

Health care workers (HCWs) can acquire infectious diseases, including coronavirus disease 2019 (COVID-19), from patients. Herein, COVID-19 is used with the source-pathway-receptor framework as an example to assess evidence for the role of aerosol transmission and indirect contact transmission of viral respiratory infectious diseases. Evidence for both routes is strong for COVID-19 and other respiratory viruses, but aerosol transmission is likely dominant for COVID-19. Key knowledge gaps about transmission processes and control strategies include the distribution of viable virus among respiratory aerosols of different sizes, the mechanisms and efficiency by which virus deposited on the facial mucous membrane moves to infection sites inside the body, and the performance of source controls such as face coverings and aerosol containment devices. To ensure that HCWs are adequately protected from infection, guidelines and regulations must be updated to reflect the evidence that respiratory viruses are transmitted via aerosols. Expected final online publication date for the Annual Review of Public Health, Volume 43 is April 2022. Please see http://www.annualreviews.org/page/journal/pubdates for revised estimates.

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Fischer, R., Port, J. R., Holbrook, M., Yinda, K. C., Creusen, M., Ter Stege, J., *et al.*
UV-C light completely blocks highly contagious Delta SARS-CoV-2 aerosol transmission in hamsters.

bioRxiv, (2022)

Behavioral and medical control measures are not effective in containing the spread of SARS-CoV-2. Here we report on the effectiveness of a preemptive environmental strategy using UV-C light to prevent airborne transmission of the virus in a hamster model and show that UV-C exposure completely prevents airborne transmission between individuals

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Miranda, M. T., Romero, P., Valero-Amaro, V., Arranz, J. I., Montero, I.
Ventilation conditions and their influence on thermal comfort in examination classrooms in times of COVID-19. A case study in a Spanish area with Mediterranean climate.
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Current evidence and recent publications have led to the recognition that aerosol-borne transmission of COVID-19 is possible in indoor areas such as educational centers. A crucial measure to reduce the risk of infection in high occupancy indoors is ventilation. In this global pandemic context of SARS-CoV-2 virus infection, a study has been carried out with the main objective of analyzing the effects of natural ventilation conditions through windows on indoor air quality and thermal comfort during on-site examinations in higher education centers during the winter season, as this implies situations of unusual occupation and the impossibility in many cases of taking breaks or leaving classrooms, as well as the existence of unfavorable outdoor weather conditions in terms of low temperatures. For this purpose, in situ measurements of the environmental variables were taken during different evaluation tests. As the main results of the study, ventilation conditions were generally adequate in all the tests carried out, regardless of the ventilation strategy used, with average CO2 concentration levels of between 450 and 670ppm. The maximum CO2 concentration value recorded in one of the tests was 808ppm. On this basis, the limit for category IDA 2 buildings, corresponding to educational establishments, was not exceeded in any case. However, these measures affected the thermal comfort of the occupants, especially when the outside temperature was below 6°C, with a dissatisfaction rate of between 25 and 72%. Examinations carried out with outside temperatures above 12°C were conducted in acceptable comfort conditions regardless of outside air supply and classroom occupancy. In these cases, the dissatisfaction rate was less than 10%. The results obtained have made it possible to establish strategies for ventilation in the implementation of future exams, depending on the climatic conditions outside.

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