Air purifiers
Background knowledge

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AEROSOLFORSCHUNG

Summary of the "Position paper of the Gesellschaft für Aerosolforschung on understanding the role of aerosol particles in SARS-CoV-2 infection"*.The position paper represents the current state of research on a very broad scientific basis. We have summarized important quotes from this position paper below:

General:

- "Aerosol particles have sizes between approx. 0.001 and several 100 micrometres (and not < 5 µm as currently defined in many publications) and spread relatively quickly with air currents, even over longer distances."
- "In still air, a 1 µm spherical aerosol particle with the density of water would take about 7.5 hours to sink to the ground from a height of 1 meter. A 10 µm particle would need only about six minutes."
- "SARS-CoV-2 has a size of 0.06 to 0.14 micrometres, but the exhaled liquid aerosol particles are larger."
- "A healthy person breathes out between one hundred and several hundred aerosol particles per litre of air during normal resting breathing, which are produced in the peripheral lung during inhalation by "reopening collapsed airways". ... they are mainly lung fluid (surfactant), with viruses also found in the particles. Hohlfeld et al. were able to determine the particle size, which is between 0.2 and 0.4 µm."
- "The authors showed that 87 % of the exhaled aerosol particles had sizes of less than 1 µm."

What can be done?

- "An effective process for reducing the concentration of particles in a room - and thus in a similar way to the concentration of virus-containing aerosol particles - is dilution with cleaner, less particle-laden, i.e. virus-free air."
- "It should be borne in mind that although the outside air is virus-free as a rule, it is not free of other air pollutants. Although the concentration of viruses can be lowered by ventilation, the general air quality in the interior may even deteriorate."
- The advantages of air purifiers compared to ventilation are that no heat escapes from the room, especially in the cold season, and their effectiveness is independent of the particle concentration in the outside air. Air purifiers can make a useful contribution to reducing the concentration of particles and viruses in a room."
- "When procuring air purifiers, care must be taken to ensure that they are adequately dimensioned for the room and application in question in order to significantly reduce the particle and virus load. The air throughput of the unit is more important than the pure efficiency of the filter."

***Source:** https://www.info.gaef.de/positionspapier

How can air purifiers contribute to more safety and what should be considered?

- "The effectiveness of air purifiers is usually assessed by means of the Clean Air Delivery Rate (CADR), which is determined in a standardised way by means of decay rates in a test chamber. The CADR indicates how many cubic metres of cleaned air the air purifier provides per hour and thus corresponds to the product of filter efficiency and volume flow rate that the unit circulates."
- "The decisive factor is therefore not only the highest possible filter efficiency, but always the combination with sufficient air turnover."
- "Current testing standards for air purifiers, such as the Chinese GB/T 18801:2015 or the US ANSI/AHAM AC-1:2015, ... The test standards mentioned above recommend about three to six air changes per hour."
- "The use of H13 and H14 filters therefore has no technical advantages and is neither economically nor energetically sensible. It can also be counter-productive to retrofit existing air purifiers with highly efficient filters, if the reduction of the volume flow rate due to the higher pressure drop exceeds the gain in filter efficiency and the CADR ultimately even decreases."
- "If, during operation, persons in the room (e.g. during school lessons or meetings), among whom an infected person is present, exhale viruses or virus-containing particles, an equilibrium concentration of viruses in the room is established over time, assuming a homogeneous distribution. The higher the CADR of the air purifier, the lower the equilibrium concentration, but it can never be exactly zero."
- "If the viruses are evenly distributed in the room, the resulting equilibrium concentration depends only on the quantity of viruses exhaled (source) and the quantity of viruses removed per unit of time (sink). ... **It was calculated that ... the risk of infection per hour of time spent in a room with an infected person can be reduced to 10%.** The risk of infection is thus minimised, but other protective measures, such as ventilation or wearing masks, must never be completely neglected."
- "For a 2.5 m high room with an area of 20 m^2 (50 m^3 room volume), an air purifier with a CADR of 300 m^3/h (6 air changes per hour) would be required. In principle, even higher air exchange rates result in an even faster decrease in particle concentration but are still associated with higher energy consumption and noise emissions. It is therefore always necessary to find a suitable compromise for the respective application."
- "As an alternative to a single unit with high CADR, several units with lower CADR can be used, ... **The use of several air purifiers can also lead to the exhaled air of individual persons being sucked in more directly, thus reducing the distribution of viruses in the room."**

Remarks:

- "Noise emissions in particular can significantly reduce acceptance in everyday life."
- "In addition, just as with ventilation, direct droplet infection between two people cannot be prevented if the distance is too small."
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- "While viruses deposited on filters with the aid of UV radiation can thus be efficiently inactivated, it is currently unclear whether the findings can be transferred to airborne viruses. The method also harbours potential risks: UV rays cause damage to human skin when irradiated directly. In addition, UV radiation can lead to the formation of ozone in the room air. Accordingly, such methods should not be used if there are people in the room who could be exposed to UV radiation or ozone."

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