Study demonstrates effectiveness of air cleaners at daycare centers

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1 April 2024

Researchers in Finland published interim results in March from an ongoing study on the effectiveness of portable air cleaners in daycare centers to reduce childhood infections. The study compared two daycare centers where they placed air cleaners to all other daycare centers in Helsinki, where air cleaners were not in use.

Parents of children in the two daycare centers with air cleaners self-reported 32 percent fewer missed days of work due to their children's illnesses as compared to parents of children in the other daycare centers. The reduction was an average of 5.53 missed days per parent to 3.77 days, during a six-month period in the winter from November 2022 to the end of April 2023.

Because of the expense of the portable air cleaners and limitations on available space in the daycare centers to place them, the researchers used a novel mathematical model to guide placement. The goal was to place air cleaners in available locations in such a way as to maximize any reduction in infections.

Their model calculates an estimated transmission probability and the number of individuals at risk for infection. The model is based on several parameters. Most relevant to the air cleaners, it includes the clean air delivery rate, an indicator of how rapidly infectious particles are removed from ambient air.

Recommendations on clean air delivery rates vary by the authority issuing them. The Lancet COVID-19 Commission Task Force on Safe School, Safe Work, and Safe Travel currently recommends a minimum clean air flow rate of 10 dm^3/s/person as "good" ventilation and a value greater than 14 dm^3/s/person as "best" ventilation. A cubic decimeter or dm^3 is equivalent to one liter or 0.035 cubic feet.

ASHRAE, formerly known as the American Society of Heating, Refrigerating and Air-Conditioning Engineers, does not have recommendations for daycare centers. However, for classrooms it recommends a flow rate of 20 dm^3/s/person for control of infectious aerosols. For lecture halls, it recommends a higher value of 25 dm^3/s/person.

Notably, both daycare centers where the researchers placed air cleaners complied with existing Finnish regulations on air flow, which specify a considerably lower minimum. For non-residential buildings, the required clean air flow is only 6 dm^3/s/person. The researchers estimated clean airflow rates for every room at both daycare centers prior to air cleaner placement and found values lower than 6 dm^3/s/person for several rooms at both daycare centers.

The researchers placed on average one portable air cleaner per room in each daycare center, resulting in 22 air cleaners placed at daycare A and 23 at daycare B. The air cleaners included 14 different models from six manufacturers. The maximum clean air delivery rates of the cleaners varied, but the study operated most cleaners at lower rates than maximum capacity due to the noise of the fans.

A strength of the study is that the researchers confirmed manufacturer specifications on clean air delivery rates prior to placing them. The clean air flow rates at which they operated the air cleaners ranged from approximately 35 dm^3/s to 417 dm^3/s with an average of 155.3 dm^3/s.

The study found that at the two daycare centers where they placed air cleaners, the placement of air cleaners increased non-infectious airflow rates considerably. Prior to air cleaner placement at daycare A, only 68 percent of the rooms met or exceeded the Lancet Task Force minimum of 10 dm^3/s/person when at maximum occupancy. For daycare B, this figure was 63 percent.

After the placement of air cleaners, the percentage of rooms that met or exceeded 10 dm^3/s/person at maximum occupancy was 90 percent at daycare A and 89 percent at daycare B. In addition, the percentage of rooms that met or exceeded the ASHRAE minimum of 20 dm^3/s/person for a classroom increased from zero to 33 percent and 32

percent for daycare centers A and B, respectively.

Overall, the clean air delivery rate in daycare centers A and B increased by 137 percent and 126 percent respectively. This represents a more than doubling of clear air delivery.

The mathematical model calculated average reductions of airborne concentrations of infectious particles of 53 percent at daycare center A and 37 percent at daycare B. Similarly, the average number of persons at risk for contracting an infection, as estimated by the model, fell by 60 percent and 53 percent at daycare centers A and B, respectively.

Based on these results and the reduction in parents' self-reported work absences of 32 percent, the researchers concluded that their targeted placement of air cleaners reduced infections on average. They noted that extensive modifications to the facilities' heating ventilation and air-conditioning (HVAC) systems would be required to achieve the levels of increased non-infectious airflow achieved with the portable air cleaners. The use of portable air cleaners provides flexibility and more immediate increases in clean air flow. It also enables studying their impact to inform broader policy on the design of HVAC systems.

The researchers note that the benefits of the air cleaners likely outweigh their costs. Lost productivity by workers taking time off to care for sick children costs the nation of Finland approximately €3.5 billion per year or 1.3 percent of its gross domestic product. If the average reduction of 32 percent of lost days to work holds up in future research and experience, then the savings on lost productivity alone is over €1 billion per year. Additional savings, as the researchers note, accrue from reduced healthcare costs, mortality, and workload on other employees.

The study has a few limitations. Parents' lost days to work were self-reported. The study included 38 parents from intervention daycare centers and 388 parents in control daycare centers. The effect of self-reporting was mitigated by the fact that parents reported outages from work on a weekly basis, reducing possible errors from trying to recall events far in the past. Also, it is important to note that parents were asked specifically about absences due to the need to care for sick children at home. The parents' response rate overall was 60-68 percent during the study period, which is considered excellent for a one-time survey, let alone weekly reporting for six months.

Another limitation was the small number of daycare centers (n = 2) with air cleaners. In an ongoing phase of the study, two additional daycare centers will have air cleaners placed.

Lastly, the researchers' mathematical model only considered the airborne route of transmission. It is known that many viruses also live on surfaces and the study did not account for such fomite-based transmission.

The study adds to the growing evidence supporting widespread implementation of air purification systems in buildings, especially in school and university buildings. Although much research has focused on the SARS-CoV-2 virus in the wake of the pandemic, air purifiers can remove airborne particles laden with other pathogens as well. Air purifiers also remove harmful smoke, pollen, pet dander and dust mites.

To further amplify the public health benefits, air purification can be combined with ultraviolet germicidal irradiation (UVGI) technology. One approach is to incorporate UVGI into HVAC ducts to kill pathogens as air flows through. Another approach is to irradiate the air in the upper portion of rooms with high ceilings, typically the top two feet of the room. Either way, the effect is to increase non-infectious airflow at a constant overall air flow.

Air purification would be an important component of any global elimination strategy for SARS-CoV-2. It would operate alongside other non-pharmacological measures, which in addition to UVGI, include masking, mass testing, quarantine, isolation and the proper use of social distancing.

Despite the growing evidence for air purifiers, UVGI, and other public health measures, the capitalist ruling elites continue to display criminal indifference to the suffering of their populations. They refuse to initiate and fund policies that would systematically incorporate increased non-infectious airflow in schools, workplaces and other public venues like airports and train stations.

In so doing, the ruling class is subordinating public health to private profit. To reduce the devastating impact of infection, including the elimination of COVID-19 worldwide, the working class must reorganize society based on social need through its own international, independent political program.