The Use of Laminar Flow To Reduce Aerosolized Particle Dispersion: A Strategy for Respiratory Disease Prevention

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Respiratory diseases such as COVID-19 and influenza predominantly spread through small micron-sized particles that have the ability to stay aloft in indoor air spaces for minutes to hours. Our prior research demonstrated significant reduction in particle concentrations in a classroom with open windows, whereas, standard A/C spread the particles widely indoors. In colder climates, however, open windows may be impractical, therefore the current study seeks to utilize the strategy of vertical laminar flow used in industrial ‘clean rooms’ to the classroom setting. The study used CO2 concentration in a 1:12 scale classroom to study gas diffusion under standard and laminar conditions. Statistical analysis demonstrated that laminar floor reduced spread of CO2 from the source to adjacent desks compared with turbulent flow of standard A/C vents (p-value=.03). In field trials, a novel laminar duct was retrofitted and fixed to the existing vents. A scanning 532nm continuous laser beam imaged micron-sized particles from a jet nozzle emitted at a student desk. A camera was used to obtain images at 30 second timed intervals for 5 minutes under standard A/C, laminar flow, still air and open window conditions. The data corroborated prior research that particles spread widely in still air as well as with standard A/C vents. Desks beneath the laminar ducts, however, experienced lower particle concentrations. This study demonstrates in both the lab model and field trials that vertical laminar flow may be an effective strategy to reduce respiratory disease transmission in indoor air spaces.

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