Comparison of Infection Risk in a Large and Small Classroom

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Comparisons have been made historically between environments with high occupant density to those with lower occupant density. Implicit in this characterization for the purpose of assessing airborne infection risk is the amount of clean air per occupant, and ASHRAE Standard 241, Control of Infectious Aerosols, takes this approach. A more common basis for comparison is the number of air changes per hour (ACH). The implication is a decreasing risk of disease with increasing ACH. This study illustrates how comparisons based on air changes per hour can fail to provide realistic risk assessments relative to airborne disease.

From published data, a larger normal sized classroom at 3.4 ACH was estimated to produce 0.239 infections after one hour for a moderately infectious strain of influenza.

A small classroom with ventilation, occupants and duration that is equal to a conventional classroom is compared on the basis of risk of airborne disease using a temporal spatial form of the Wells-Riley equation. Passive scalar, Eulerian and Lagrangian methods were used in the CFD models. A relatively large aerosol of 5 mm diameter non-sticking was used to find worst case particle inhalation.

Although the small classroom had a much higher 34.25 ACH than the large classroom 3.4 ACH, the passive scalar, Eulerian and Lagrangian models predicted 0.354, 0.646 and 0.336 infections respectively after one hour or roughly 44%, 170% and 41% more inhaled aerosols.

References:

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