



KEY POINT SUMMARY

OBJECTIVES

To take baseline measurements using food dye as part of a longer-term project that demonstrates the effects of door-opening motions using a variety of doors and occasional human figures.

DESIGN IMPLICATIONS

Sliding doors contribute to significantly less air disturbances as opposed to hinged doors, which is an important distinction to note when designing isolation rooms. However, regardless of door types, the movement of humans through doorways will likely create some degree of air leakage, thus suggesting that anterooms should be a required design objective.

Different types of door-opening motions as contributing factors to containment failures in hospital isolation rooms

Tang, J. W., Nicolle, A., Pantelic, J., Klettner, C. A., Su, R., Kalliomaki, P., ... & Cheong, D. K. 2013 | *PLOS One*. Volume 8, Issue 6, Pages 1-10

Key Concepts/Context

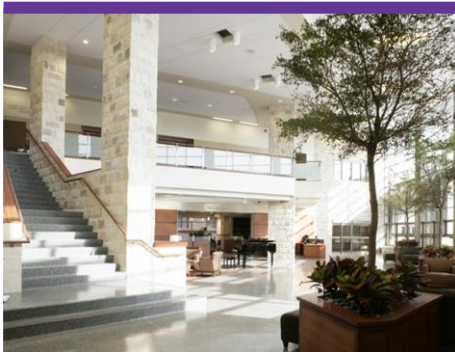
When under negative pressure, hospital isolation rooms are essential for both the containment of patients emitting airborne infectious agents as well as the protection of other patients from these agents. A plethora of different doors are used in the construction of these rooms, but relatively few studies have analyzed how certain door-opening motions and the passage of healthcare workers through these doors can affect the overall performance of isolation rooms.

Methods

Two 1:10 scale water-tank models of hospital isolation rooms were used in this study, with one tank accommodating double- and single-sliding doors, and the other accommodating double- and single-hinged doors. Water with food coloring was used to simulate airflow, and the same scale model of a male human figure moved across a sliding track in each tank to simulate realistic walking speeds. Backlights helped illuminate the fluid while two cameras captured the motion of the flowing food dye across time. A variety of movements with the male figure were tried with different door positions. Qualitative descriptions of the water flow patterns were noted in the context of different manikin movement and door movement velocities.

Findings

Inspection of the film revealed that single doors produced less disturbance than double doors, and sliding doors produced significantly less air exchange than hinged doors. Thus, grading doors in terms of the potential for door-opening motions to incite bulk airflow movement across doorways, the order would be single sliding < double-sliding < single-hinged < double-hinged. The movement of the manikin



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caused significant airflow disturbance with sliding doors, but not as much with hinged doors, since the hinged doors themselves already disturbed airflow.

Limitations

The authors noted that no ventilation airflow was simulated in this study, and the airflow motions described using the food dye were only qualitative.

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