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


**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
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.