SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

To examine the effect of simulated human passage, realistic ventilation rates, and supply-exhaust flow rate differentials on airflow patterns generated by hinged and sliding doors.

DESIGN IMPLICATIONS

Negative pressure isolation rooms should be strategically located and constructed to minimize the possibility of hospital cross-infection via airborne pathogens. Ultimately, this study shows that sliding doors, rather than hinged doors, can substantially reduce potentially harmful airflow to and from isolation rooms.

Airflow patterns through single hinged and sliding doors in hospital isolation rooms - Effect of ventilation, flow differential and passage

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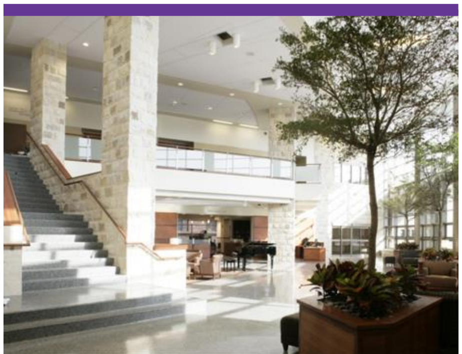
Key Concepts/Context

Patients with highly contagious diseases are often housed in negative pressure isolation rooms. These rooms attempt to reduce cross-infections within the hospital. However, airflows produced by healthcare worker movements and door opening motions pose the risk of spreading pathogen-laden air from negative pressure isolation rooms into other spaces. A significant number of previous studies have examined the impact of single-hinged door-generated airflows, but few have compared hinged doors with sliding doors.

Methods

All experiments were conducted in a full-scale model of an isolation room area. The model featured two adjacent and identical rooms (each 3.0 m high, 4.0 m long, and 4.7 m wide) that were joined by a door in a central dividing wall. “Room 1” acted as an anteroom and “Room 2” represented the actual isolation room itself. The interiors of both rooms were painted black to enhance the visibility of smoke. Tests were carried out first with a single-hinged door (opening towards Room 2) and then for a sliding door (mounted on Room 1’s side of the doorway). One ‘test’ would consist of six door openings separated by 60 minutes each, with a 1.7 m tall manikin moving through the doorway at a speed of 1 m/s (meter per second). Smoke was produced to simulate the airflow patterns across the doorway induced by the presence of the hinged and sliding doors along with the movement of the manikin. “Mixing ventilation” was used during each test, along with two air change rates with flow rates of 94 and 188 l/s (liters per second).



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Findings

Results indicated that the operation of a single sliding door resulted in less airflow across the isolation room doorway, and thus performed notably better than a single-hinged door. The authors posit that sliding doors should be considered the primary door types for isolation rooms. The efficacy of ventilation in the study proved difficult to assess; smoke was diluted and mixed by the ventilation, causing it to usually disappear quickly. The movement of the manikin showed that bodies traversing doorway thresholds do in fact carry significant amounts of air (and potential pathogens) in their wake.

Limitations

The authors note that more realistic parameters could have been used in the study, such as additional flow rate differentials, actual human movement, and realistic heat loads. Since all results from this study stem from the same model space, the results may not apply to isolation rooms universally. Additionally, the use of smoke as a representative for pathogen-laden air might not account for how some airborne pathogens are transmitted.

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