SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

The objective of this study was to examine the impact of human walking on the flow and airborne transmission in a six-bed hospital ward.

DESIGN IMPLICATIONS

Given the authors' caveat about the need for investigating other variables, it is too early to infer design implications from this study.

The influence of human walking on the flow and airborne transmission in a six-bed isolation room: Tracer gas simulation

Hang, J., Li., Y., & Jin, R. 2014 | *Building and Environment.* Volume 77, Pages 119-134

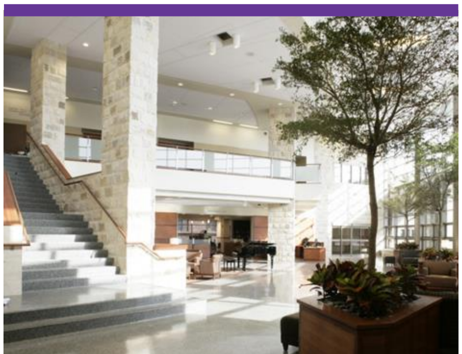
Key Concepts/Context

The authors allude to the outbreak of Severe Acute Respiratory Syndrome or SARS and influenza in hospital wards to emphasize the need to protect healthcare workers (HCWs) and non-infected patients. According to the authors, literature indicates that movement of HCWs in hospital wards contributes to the transmission of airborne contaminants. Computational Fluid Dynamics (CFD) was used to simulate the movement of a HCW in an isolation ward and its impact on airborne transmission. It was found that the walking does disturb the flow and facilitates airborne transmission; however, the location of the exhaust fans and Air Change rate (ACH) were more significant than the movement of the HCW.

Methods

In this research CFD simulations were conducted to study the impact of the walking motion of HCWs on the dispersion of gaseous contaminants. The simulated setting was a six-bed isolation ward. It had nine downward air supplies and six ceiling- or floor-level exhausts. The CFD software, FLUENT 6.3, was used to simulate indoor turbulent flow and the movement of the human body. Tracer gas was used to simulate the release of gaseous contaminants. A total of five tests were examined in the following different conditions:

- Case 1: Ceiling-level exhaust was open and floor-level exhaust was closed. ACH was 12.9 with a realistic HCW model (Body A) simulating the actual walking motions of humans.
- Case 2: Ceiling-level exhaust was closed and floor-level exhaust was open. ACH was 12.9 (with Body A).



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- Case 3: Ceiling-level exhaust was open and floor-level exhaust was closed. ACH was 6 (with Body A).
- Case 4: Ceiling-level exhaust was open and floor-level exhaust was closed. ACH was 12.9 with a HCW model represented by a rectangular block without arms or legs (Body B).
- Case 5: Ceiling-level exhaust was open and floor-level exhaust was closed. ACH was 12.9 with Body A having a surface heat flux.

Findings

The concentration of the tracer gas in Case 1 was lower than Case 2, implying that ceiling-level exhausts are more efficient at removing gaseous contaminants. The HCW walking does not affect this.

- In cases 1 and 2 it was seen that the contaminant was carried from the source to other side of the room by the walking of the HCW because of the wake created behind the worker.
- There was little spread of contaminant during the walking. However, after the HCW stops, the residual wake continues to spread the gas.
- The time taken for contaminant concentration levels to return to their initial levels takes between 30 to 60 seconds after the HCW stops walking.
- Ceiling ventilation is more effective at removing contaminants transported by human walking, as is seen in the higher concentration of gas in Case 2 than Case 1 after passage of time.
- Comparison between Cases 1 and 3 show that with decrease in ACH, there is a higher concentration and a wider spread of gaseous contaminant.
- In Case 3, it takes more time for the contaminants to be removed from or diluted near the HCW than in Case 1.
- When Body B is used to simulate the HCW (Case 4), it was seen that the realistic human model (Body A) generates less flow disturbance. Body B generates a stronger wake – and the potential for contaminants to travel further.
- When there is a surface heat flux (Case 5), there is a wider spread of contaminants from the infected patient than in Case 1.

Limitations

The authors do not identify any limitations in their study other than the need for examining other activities to have a complete understanding of the influence of HCW walking on airborne transmission.

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