SYNOPSIS

KEY POINT SUMMARY

Does a mobile laminar airflow screen reduce bacterial contamination in the operating room? A numerical study using computational fluid dynamics technique

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OBJECTIVES

To assess whether mobile laminar airflow units paired with conventional turbulent-mixing ventilation in operating rooms reduce the same level of airborne bacteria and bacteria-carrying particles as laminar airflow systems.

DESIGN IMPLICATIONS

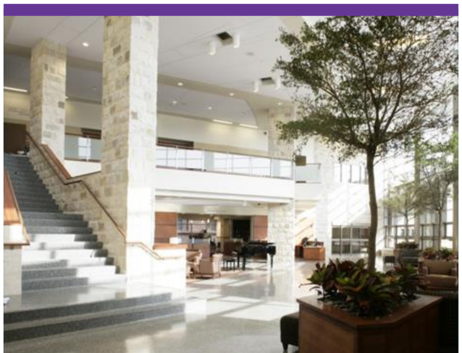
MLAFs may be ideal for smaller or more cramped ORs where moving the ventilation system around will help with the movement of personnel and other pieces of equipment in the room. They are also ideal for these settings due to their effective range of 1m. The authors mentioned that MLAFs could be more cost-efficient as opposed to LAFs.

Key Concepts/Context

Surgical-site infections (SSIs) can increase patient morbidity and mortality and extend hospitalization time. Operating room (OR) personnel are the main source of airborne bacteria; a person releases roughly 104 skin scales per minute while walking, 10% of which carry bacteria, although up to 12 times as many microorganisms may be discharged depending on the individual and situation. Bacteria in the OR might contaminate a surgical wound through contact with the air or through contaminated surgical instruments. Efficient air ventilation systems can effectively dilute and evacuate contaminants from the OR, and mobile laminar airflow (MLAF) units in particular may be useful for moving around physical obstacles in the OR while also cutting down overall expenses.

Methods

- The physical model for this study was an OR with dimensions of L 8.5m x W 7.7m x H 3.2m.
- Ventilating air came through 24 diffusers that were evenly spaced over the ceiling, creating a total airflow rate of 2500 L/s and yielding a design ventilation rate of 47 air changes per hour (ACH). Exhaust openings placed on parallel vertical walls at floor level extracted outgoing air.
- 10 surgical staff members, mostly around the operating table, were in upright stationary positions.
- At the foot end of the operating table was a MLAF (TOUL-400) screen, with airflow directed along the table. Also included were two sterile instrument tables equipped with MLAFs (TOUL-300).



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- In accordance with SIS-TS 2012, five CFU/s (colony-forming units per second) per individual were considered.
- Different MLAF centerline velocities, from zero (unit switched off) to 1.0 m/s were performed during the simulation.
- Active air sampling (AAS) was used to estimate the amount of CFUs in the sampled air, with a flow rate of 100 L/min drawn for 10 min. through a slit sampler above each table. For passive air sampling (PAS), the OR tables were exposed to the OR air for one hour. Sedimentation rates were also taken from the periphery of the OR. Air sampling was repeated 100 times.

Findings

CFU counts showed decreases in every area measured of the OR when MLAF airflow was functioning. Even if the MLAF screen is functioning at a minimum velocity of 0.4m/s, the desired count of CFUs for infection-sensitive surgeries (such as knee or hip surgery) would be reached. Optimal positioning of the MLAF screen units was critical for efficiency; efficacy for removing pathogens before they settle can be accomplished from about 1m away from the MLAF screen, but no further. This also points out a limitation in the MLAF's utility.

Limitations

One limitation is the use of the static variable used to account for colony-forming units emitted from individuals; some people in an OR may emit higher amounts of microorganisms than others. The study was also conducted in a newly designed, well-equipped operating room; older operating rooms may have turned up higher levels of CFUs on all measurements.

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