Operating Room Airborne Microbial Load; Non-Scrubbed Staff Apparel Matters

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Introduction:

Periprosthetic joint infection is the leading cause of total joint replacement failure. One possible contributing factor is the airborne microbial load of the operating room. In a previous study, we found a statistical correlation between the level of contamination and the airborne particle concentration with the number of staff present in the OR. In the current study, we focused on the apparel of non-scrubbed OR staff to elucidate the contribution of different manners of dress to the airborne microbial load and the viable contaminate settle rate.

Methods:

The aim of this study was to measure any differences in the contribution of viable particles to the airborne microbial load of a room while wearing approved and alternative OR garb. The garb of group 1 (approved) consisted of hospital laundered scrubs, hospital laundered jacket, hair bonnet, face mask, and shoe covers. Group 2 donned disposable sterile cleanroom coveralls with zipper closure and elastic wrists and ankles over the scrubs and likewise wore a disposable hair bonnet, face mask, and shoe covers. These groups were tested against each other in an isolation chamber and also in an operating theater.

A 1.4m^3 isolation chamber was constructed having a filtered air intake and controllable exhaust. The sealed chamber was outfitted with a wall mounted work surface opposite of a waist level wall mounted shelf. Upon testing, a group member entered the chamber and exposed two tryptone and two saboraund agar settle plates that were positioned on the opposing shelf to the ambient chamber air. An anemometer (BT-846A, BTMeter) was used by an outside staff member to adjust the inline exhaust fan to allow nine air exchanges per hour. The group member then conducted a series of scripted tasks for one hour which included walking in place, opening sterile packs, picking items from a tray, and standing in place. Upon the test's end, the group member covered the agar plates and exited the chamber with the plates for incubation. The isolation chamber was then cleaned in ethanol and the test was repeated by the same individual now dressed as a group 2 member. Each session consisted of two tests by the same individual on the same day. The order of testing of each group was also alternated for each subsequent session.

We then set out to determine how the results of the isolation chamber translated to the sterile field and periphery of the larger volume OR as air exchange units and staff proximity restraints are in place. This was determined through a simulated procedure within an OR while it is not in use. For one hour four lab members acting as group 1 conducted maneuvers in an OR that imitated movements of the nurse, anesthesiologist, company rep, and entering/circulating/exiting staff. Passive agar plate sets were placed at the nurse's station, patient table, instrument table, and anesthesiologist's station to collect viable settling contaminates. Additionally, an active particle counter was placed on the instrument table within the simulated sterile field to measure the airborne particulate concentration during each session. After one hour, the staff exited the OR and donned the sterile cleanroom coveralls of group 2. The simulation was repeated in the same OR on the same day by the same individuals. All measures for both phases were averaged and reported in units of colony forming units/m^2/hour for the settle plates and particles/m^3 for the airborne concentrations.

Results:

There was approximately a 10-fold difference in the settle rate of viable particles collected during the testing of standard scrubs vs alterative garb in the isolation chamber. The settle rate for the scrubs group was 5519 ±1381 CFUs/m^2/hr, while the settle rate for the coveralls group was 505 ±55 CFUs/m^2/hr ($p=0.008$). This was a 91% reduction (Figure 1).

During the testing of the scrubs group in the OR, 218.7 ±35 CFUs/m^2/hr were captured verses 50.5 ±13 CFUs/m^2/hr for the coverall group ($p<0.01$). The concentration of airborne particles collected by the particle counter in the OR for the scrub group was 4952.1 ±495 particles/m^3 and 1065 ±53 particles /m^3 for the coveralls ($p<0.01$). This was a 77% and 79% reduction for both measures respectively (Figure 2).

Conclusion:

OR personnel are a primary contributor to the airborne microbial load. A significant reduction of potential contaminants was found in both methods of measure when comparing standard OR scrubs to cleanroom coveralls. These results suggest that changing the non-scrubbed OR staff's apparel may be a beneficial infection prevention strategy.

Significance:

The open and loose nature of standard scrubs allow the escape of particles into the ambient environment whereas the one-piece zippered design of the coveralls with elastic wrists and ankles restrict pathways of particle escape. The results of this study may be helpful when developing hospital infection prevention policies.

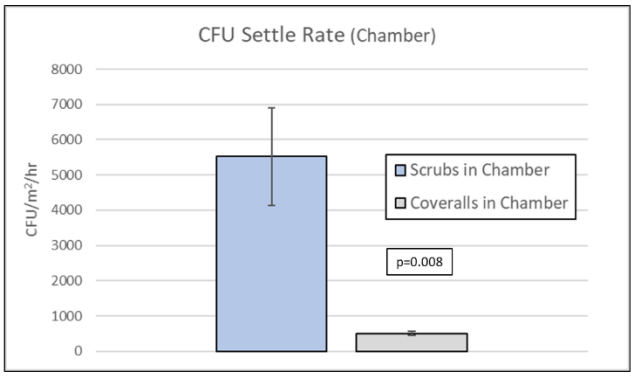

Figure1. Chart showing the viable particle settle rate inside the isolation chamber for each group.

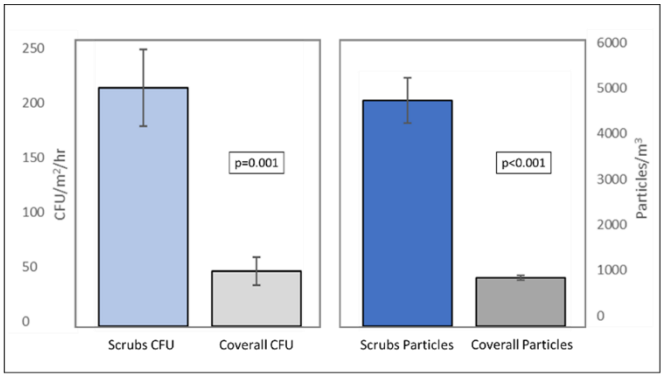

Figure2. Chart showing the viable particle settle rate inside the OR for each group (left) and the airborne particle concentration inside the OR for each test group (right).