Evaluation of N95 Respirator Use with a Surgical Mask Cover: Effects on Breathing Pressures, Inhaled Carbon Dioxide and Inhaled Oxygen Concentrations

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Objective: To reduce the threat of exhausting FFR supplies during pandemic influenza outbreaks, the Institute of Medicine has recommended using surgical mask covers (SM) over N95 filtering facepiece respirators (FFR) among healthcare workers as one strategy to avoid surface contamination of the FFR. The objective of this investigation was to measure breathing air quality and breathing pressures when using FFR with FDA-cleared SM and without SM.

Methods: Thirty NIOSH-approved FFR models with and without SM were evaluated using the NIOSH Automated Breathing and Metabolic Simulator (ABMS) through six incremental work rates.

Results: Generally, concentrations of average inhaled carbon dioxide (CO_2) decreased and average inhaled oxygen (O_2) increased with increasing O_2 consumption for FFR+SM and FFR-only. For most work rates, peak inhalation and exhalation pressures were statistically higher in FFR+SM compared to FFR-only. The type of FFR and the presence of exhalation valves (EV) had significant effects on average inhaled CO_2, average inhaled O_2, and breathing pressures. Results suggest placement of a SM on one type of FFR *improved* inhaled breathing gas concentrations over the FFR *without* SM; the placement of a SM over a FFR+EV likely will prevent the EV from opening regardless of activity intensity; and, at lower levels of energy expenditure, EV in FFR do not open either with or without a SM.

Conclusions: The differences in inhaled gas concentrations in FFR+SM and FFR-only were significant, especially at lower levels of energy expenditure. The orientation of the SM on the FFR may have a significant effect on the inhaled breathing quality and breathing pressures, although the measureable inhalation and exhalation pressures caused by SM on FFR for healthcare users likely will be imperceptible at lower activity levels.