Simulated Workplace Protection Factor of Facepiece Filtering Respirators and Surgical Masks against Surgical Smoke

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ABSTRACT

Introduction: Use of electrocautery and other surgical equipment generates surgical smoke in operating rooms (ORs). The smoke contains a variety of substances in gaseous and especially particulate phases that are capable of causing health effects in healthcare workers. Disposable protection devices such as surgical masks and filtering facepiece respirators are commonly used by the OR healthcare personnel; however, no information is available about their effectiveness against surgical smoke. Scientifically credible data are needed to develop recommendations on the types and models of respirators that provide appropriate protection against surgical smoke particles.
Objectives: Determine the simulated workplace protection factors (SWPFs) of two surgical masks and two NIOSH-certified N95 filtering facepiece respirators (FFRs) currently marketed for use in ORs. Measure SWPFs on ten human subjects while they are exposed to surgical smoke generated by an electrocautery unit applied to an animal tissue in a room-size chamber.
Methods: Each subject wearing a surgical mask or a FFR applied an electrocautery unit to the animal tissue mimicking a conventional surgical procedure in an exposure chamber (24 m^3). The aerosol sampling probes were installed inside and outside the tested respiratory protection device to measure the aerosol concentrations inside (C_{in}) and outside (C_{out}), respectively, using an optical particle counter (OPC) (Model 1.108, Grimm Technologies, Inc., Ainring, Germany) and an aerosol size spectrometer (Nanocheck, Model 1320, Grimm Technologies, Inc., Ainring, Germany). The SWPF were determined as C_{out}/C_{in}.
Results: The following SWPFs values were obtained (the number represents a geometric mean with a geometric standard deviation presented in parentheses): 1.49 (1.95) and 1.76 (1.71) for two surgical masks; 263 (2.16) and 208 (2.31) for FFRs. No significant difference was observed between the two surgical masks; similarly no significant difference was found between the two N95 FFRs. However, the SWPFs of FFRs were significantly higher than those measured for surgical masks. No notable particle size dependency of the SWPF was observed; it is partially due to high between-subject data variability.
Conclusions: Wearing N95 FFRs significantly reduces the exposure to surgical smoke in an OR environment. The protection offered by the tested surgical masks was very low.
Acknowledgement: The effort was partially funded by the National Institute for Occupational Safety and Health Pilot Research Project of the University of Cincinnati Education and Research Center grant T42-OH008432.

13th Annual Regional National Occupational Research Agenda (NORA) Young/New Investigators Symposium

April 16-17, 2015
Salt Lake City, Utah

CO-SPONSORED BY:

The Rocky Mountain Center for Occupational and Environmental Health

and

The Department of Mechanical Engineering

at the

University of Utah

FUNDED BY:
A grant from the National Institute for Occupational Safety and Health