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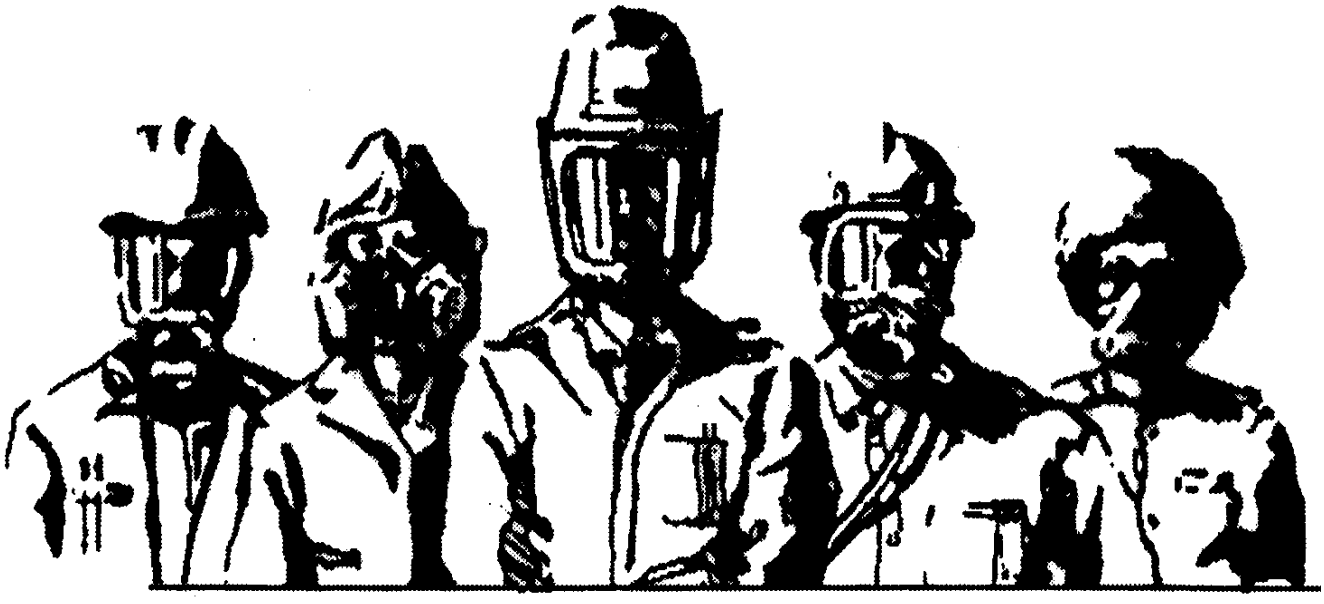

Evaluating Simulated Workplace Protection Factors for a First Responder Low-Level Protective Ensemble

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ABSTRACT

First responders are required to wear multiple layers of personal protective equipment while performing a range of physiologically demanding tasks for long periods of time. They are often required to wear high levels of respiratory protection, which can adversely impact their ability to work safely. The goal of this study was to evaluate the respiratory protective performance of a nominally lower level protective system in the course of performing typical first responder activities, which included an N95 filtering facepiece respirator in combination with a disposable hooded suit and latex gloves.

Methods: Eleven subjects (10 male; 1 female) were recruited for a range of facial sizes. Each subject donned an N95 filtering facepiece respirator following the Canadian fit test protocol. The subject then donned the hood, entered a test chamber and performed a 31-min exercise protocol. Using two Portacount instruments, one-second real-time measurements of particulate concentration were simultaneously performed inside and outside the respirator facepiece. Subjects exited the chamber, removed the hood and completed a final quantitative fit test.

Results: While limited by the small number of subjects and few small faces, we were able to show that N95 filtering facepiece respirators can provide a high degree of protection (simulated workplace protection factors ranging from 100-1000). We found no consistent relationship between initial and final fit factors. Final fit factors and SWPF were strongly correlated.

Conclusion: The two-instrument method combined with a challenging exercise protocol can elucidate several important respirator performance factors, including most challenging work tasks, effects of sweating and higher metabolic output, and interactions from other personal protective equipment.

Keywords: Simulated workplace protection factors, First responders, Ensemble, Personal protective equipment (PPE).

MS2 Coliphage as a Surrogate for 2009 Pandemic Influenza A (H1N1) Virus (pH1N1) in Surface Survival Studies on N95 Filtering Facepiece Respirators

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ABSTRACT

Research on influenza viruses regarding transmission and survival has surged in the recent years due to infectious emerging strains and outbreaks such as the 2009 Influenza A (H1N1) pandemic. MS2 coliphage has been applied as a surrogate for pathogenic respiratory viruses, such as influenza, as it's safe for personnel to handle and requires less time and labor to measure virus infectivity. However, direct comparisons to determine the effectiveness of coliphage as a surrogate for influenza virus regarding droplet persistence on personal protective equipment such as N95 filtering facepiece respirators (FFRs) are lacking. Persistence of viral droplets deposited on FFRs in healthcare settings is important to discern due to the potential risk of infection via indirect fomite transmission. The objective of this study was to determine if MS2 coliphage could be applied as a surrogate for influenza A viruses for studying persistence when applied to the FFRs as a droplet. The persistence of MS2 coliphage and 2009 Pandemic Influenza A (H1N1) Virus on FFR coupons in different matrices (viral media, 2% fetal bovine serum, and 5 mg ml^{-1} mucin) were compared over time (4, 12, 24, 48, 72, and 144 hours) in typical absolute humidity conditions (4.1×10^5 mPa [18°C/20% relative humidity (RH)]). Data revealed significant differences in viral infectivity over the 6-day period (H1N1- $P < 0.0001$; MS2 - $P < 0.005$), although a significant correlation of viral $\log_{10}$ reduction in 2% FBS ($P < 0.01$) was illustrated. Overall, MS2 coliphage was not determined to be a sufficient surrogate for influenza A virus with respect to droplet persistence when applied to the N95 FFR as a droplet.

Keywords: Pandemic influenza A virus, H1N1, MS2 coliphage, infectivity, surrogate, respirator.

Correlating and Extrapolating Air-Purifying Respirator Cartridge Breakthrough Times – A Review

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ABSTRACT

Air-purifying respirator cartridges for gas and vapor removal from breathed air have been tested for over a century. Usually gas or vapor breakthrough times have been measured with other conditions (air flow rate, humidity, temperature, concentration, etc.) fixed or varied systematically. With the accumulation of such data, various models have been proposed and used for correlating and extrapolating measured breakthrough times for air-purifying respirator cartridges and canisters. These models, ranging from simple equations to Rules of Thumb to elaborate computer programs, have been critically reviewed to 1) gather these models together into one document, 2) define their requirements and limitations, and 3) demonstrate their usability for extrapolating air-purifying respirator cartridge breakthrough time measurements to untested conditions (concentrations, humidities, temperatures, breathing rates, and covapors).

Keywords: Air-purifying respirator, cartridge, canister, breakthrough time, extrapolation.