Abstract

Large discrepancies between laboratory permeation testing and field exposures have been reported, with indications that hand movement could account for a portion of these differences. This study evaluated the influence of simulated movement on chemical permeation of 30 different disposable nitrile glove products. Products were investigated out-of-box and with exposure to simulated whole-glove movement. Permeation testing was conducted using ethanol as a surrogate test chemical. A previously designed pneumatic system was used to simulate hand movement. No movement and movement tests were matched-paired to control for environmental conditions, as were statistical analyses. Permeation data were collected for a 30-min exposure period or until a breakthrough time (BT) and steady-state permeation rate (SSPR) could be determined. A third parameter, area under the curve at 30 min (AUC-30), was used to estimate potential worker exposure. With movement, a significant decrease in BT ($p \leq 0.05$), ranging from 6-33%, was observed for 28 products. The average decrease in BT was 18% ($p \leq 0.001$). With movement, a significant increase in SSPR ($p \leq 0.05$), ranging from 1-78%, was observed with 25 products. The average increase in SSPR was 18% ($p \leq 0.001$). Significant increases in AUC-30 ($p \leq 0.05$), ranging from 23-277%, were also observed for all products where it could be calculated. On average, there was a 58% increase ($p \leq 0.001$). The overall effect of movement on permeation through disposable nitrile gloves was significant. Simulated movement significantly shortened the BT, increased the SSPR, and increased the cumulative 30-min exposure up to three times. Product variability also accounted for large differences, up to 40 times, in permeation and cumulative exposure. Glove selection must take these factors into account. It cannot be assumed that all products will perform in a similar manner.