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Influence of secondary aspiration on Human aspiration efficiency

K.R. Anderson, T. Renee Anthony

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Title: Influence of Secondary Aspiration on Human Aspiration Efficiency

Authors: KR Anderson[1,2], T. Renee Anthony[1]

[1]Department of Occupational and Environmental Health, University of Iowa, 105 River Street, Iowa City, IA, 52242

[2]Department of Environmental and Radiological Health, Colorado State University, Fort Collins CO (now at address)

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Abstract

Computational fluid dynamics (CFD) was used to evaluate the contribution of secondary aspiration to human aspiration efficiency estimates using a humanoid model with realistic facial features. This study applied coefficient of restitution (CoR) values for working-aged human facial skin to the facial regions on the humanoid CFD model. Aspiration efficiencies for particles ranging from 7-116 µm were estimated for bounce (allowing for secondary aspiration) and no-bounce (CoR=0) simulations. Fluid simulations used the standard k-epsilon turbulence model over a range of test conditions: three freestream velocities, two breathing modes (mouth and nose breathing, using constant inhalation), three breathing velocities, and five orientations relative to the oncoming wind. Laminar particle trajectory simulations were used to examine inhaled particle transport and estimate aspiration efficiencies. Aspiration efficiency for the realistic CoR simulations, for both mouth- and nose-breathing, decreased with increasing particle size, with aspiration around 50% for 116 µm particles. For the CoR=0 simulations, aspiration decreased more rapidly with increasing particle size and approached zero for 116 µm compared to realistic CoR models (differences ranged from 0 to 80% over the particle sizes and velocity conditions).