

Intra-human Variability in Nasal Dosimetry Among Four Individual

The US EPA's default dosimetric methods for soluble and/or reactive gases assumes complete gas extraction in the nasal passages and that gas uptake is uniformly distributed over the entire nasal surface area. A 10-fold uncertainty factor is used to account for intra-human variability. To examine these assumptions, computational fluid dynamics (CFD) meshes of four individual's nasal passages were constructed from MRI scans. Subsequently, these CFD meshes were used to simulate nasal uptake of a low molecular weight gas under steady-state airflow conditions using allometrically scaled resting minute volumes. Detailed profiles of gas mass flux to the nasal walls were generated for theoretical conditions of high (maximum nasal flux values was calculated by taking the ratio of each flux value to smallest value in an individual). Body weight of the four individuals ranged from 55.74 kg. Calculated minute volume ranged from 12.9 to 16.2 L/min, and nasal surface area ranged from 220 to 281 cm². Simulated maximal nasal extraction ranged only from 84% to 90%. Variability in simulated maximum and average nasal flux values was less than three-fold in both high and moderate extraction cases. These results provide an indication of the amount of variability in nasal dose that may be attributable to inter-individual differences in nasal anatomy. Additional individuals, particularly children and adults extending the body weight range, should be studied in any future work. The research was funded by the U.S. EPA (EP05C000009)