

Dispersion and Deposition of Inhalation Therapy Sprays in the Larynx and Trachea Using Experimental and Numerical Methods ‡

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This study explores deposition levels of the inhaled sprays on the anterior and posterior side surfaces of the human throat using numerical methods. The study also compares experimental and numerical characterizations of turbulence levels within the human throat. The numerical simulations of dispersion and deposition of inhalation therapy sprays in the asymmetrical laryngeal constriction and trachea are performed by using the KIVA-3V code. Phase Doppler Interferometry is used to measure the turbulent intensity within a simple throat model. Using the numerical code, ensembles of several thousand (droplet) parcel trajectories are evaluated and statistically analyzed to determine the droplet deposition ratio between the anterior and posterior sides of the trachea. Deposition levels are compared to turbulence levels along the length of the trachea.

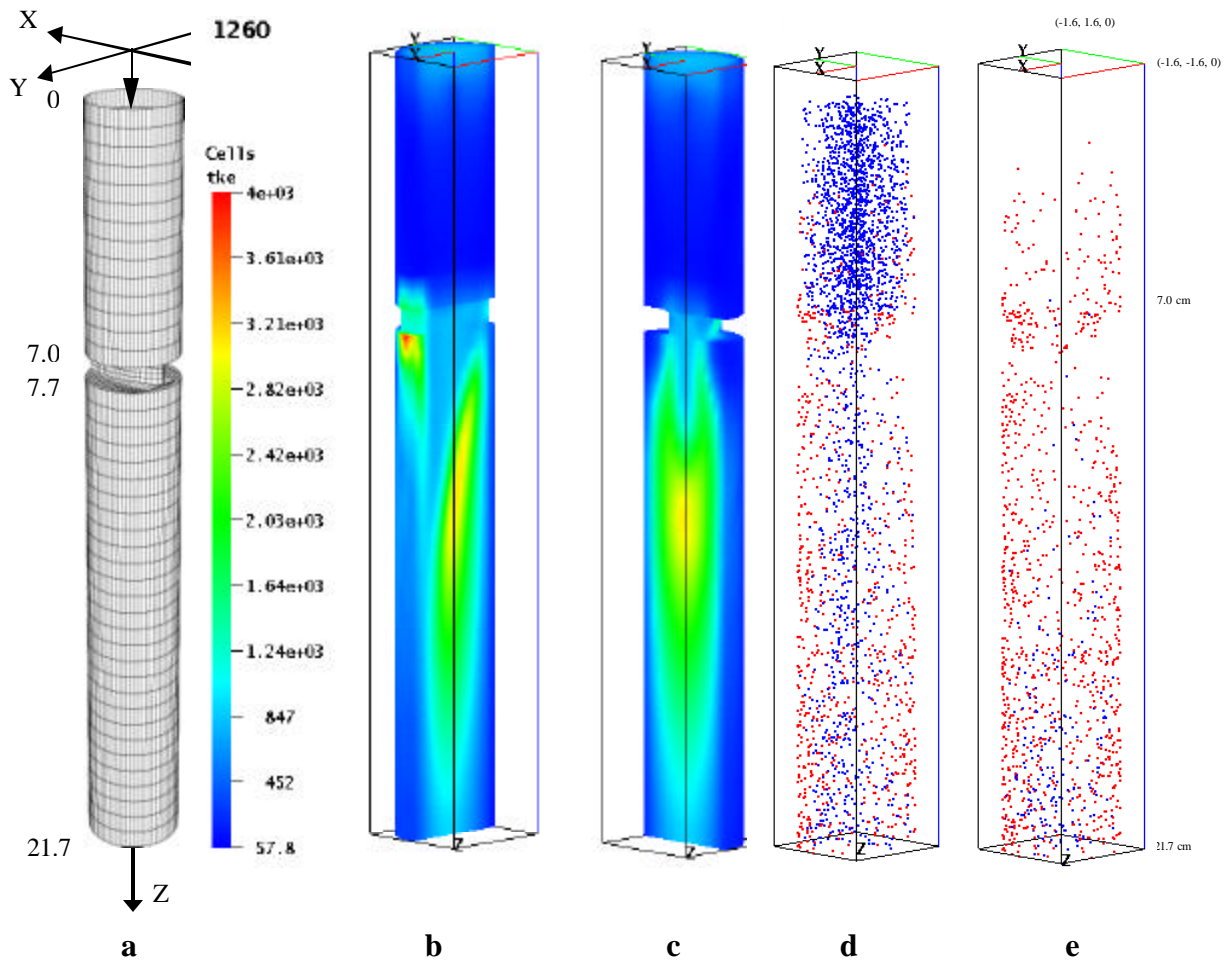


Figure: CFD mesh of the larynx and trachea (a); Turbulent kinetic energy (tke, cm^2/s^2) in the anterior-posterior plane ($Y > 0$) (b) and the medial-lateral plane ($X < 0$) (c) for the $W_0 = 0.46$ m/s inlet velocity case; Droplet parcel trajectories at problem time $t = 0.395$ sec (d) and $t = 0.478$ sec (e) for the $W_0 = 0.98$ m/s inlet velocity case. Droplet parcels suspended in the flow are shown in blue while the deposited parcels are red. Droplets entered the flow field at $Z = 1$ cm starting at $t = 0.1$ sec with an injection duration time of $\Delta t = 0.3$ sec.