Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Can we use CFD to improve targeted drug delivery in throat?[1]
SAIKAT BASU, South Dakota State University, RUPALI SHAH, ANDREW PAPPA, JIHONG WU, ALYSSA BURKE, WILLIAM BENNETT, WANDA BODNAR, JULIA KIMBELL, University of North Carolina at Chapel Hill — Numerical simulations of respiratory airflow and particle transport, along with synergistic physical experiments, can be used to identify the nebulized particle sizes that are most effective in enhancing targeted deposition at the laryngeal vocal fold granulomas in human throats. Narrow tracheal geometry results in high-speed inhaled airflow, leading to transitional and turbulent flow features. To account for short time-scale effects such as vortices, which can affect particle transport, our computational modeling scheme implements Large Eddy Simulations (LES) in three CT-derived anatomic mouth-nose-trachea reconstructions. To validate the numerical predictions, two distinct in vitro techniques, namely gamma scintigraphy and mass spectrophotometry, are used for measuring topical deposition in one CT-based solid model. Findings suggest a specific range $\approx 8 - 10$ μm of particle sizes with laryngeal granulomas and glottis as the specific deposition sites. The study considers three granuloma sizes (small, 3 mm; medium, 4.5 mm; large, 6 mm diameter) positioned at three distinct locations along the tissue lining of the vocal folds. The results have the potential to come up with novel personalized therapy protocol.

[1]Supported jointly by the National Center for Advancing Translational Sciences (NCATS), of the National Institutes of Health (NIH), through grant award UL1TR002489; and by the National Heart, Lung, and Blood Institute (NHLBI) of the NIH, under award R01HL122154

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Date submitted: 28 Jul 2019 Electronic form version 1.4