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Gel-on-Brush Model of Airway Surface of the Lung: its Predictive Role in Chronic Pulmonary Disease[1] LIHENG CAI, BRIAN BUTTON, CAMILLE EHRE, RICHARD BOUCHER, MICHAEL RUBINSTEIN, University of North Carolina at Chapel Hill —
Clearance of mucus is the primary defense mechanism that protects airways from inhaled infectious and toxic agents. The current two-layer Gel-on-Liquid model in which a gel-like mucus is propelled on top of a "watery" periciliary layer (PCL) surrounding the cilia does not adequately describe efficient mucociliary clearance in health nor properly predict failure of mucus clearance in disease. We propose and provide evidence for a qualitatively different Gel-on-Brush model with a gel-like mucus layer in contact with a "brush-like" periciliary layer, composed of macromolecules tethered to the airway surface. The relative osmotic moduli of the mucus layer to the "brush-like" PCL layer explain both the stability of mucus clearance in health and its failure in airway disease. Our Gel-on-Brush model of airway surface layer opens important new directions for treatments of airway disease.

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