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In the present work, we aim to develop an in-silico model of mucociliary clearance for PCD patients and to use this computational platform to explore the inhalation of pharmaceutical agents for the treatment of PCD symptoms. For this purpose, we will use ex vivo visualization data available at RespiHub and its network of collaborators to develop patient-customized models of ciliary motion for pre-selected PCD variants.

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In the lungs, the first line of defense against bacterial infection is the thin layer of airway surface liquid (ASL) lining the airway surface. ASL is considered as being composed of two separate layers: 1- The lower periciliary liquid layer (PCL) consists of a watery liquid within which an array of cilia has performs a cyclic beating motion; 2- The upper mucus layer is a more viscous and sticky fluid whose main mission is entrap foreign particles.

The self-clearing mechanism of the airways in the respiratory system which relies on the production of ASL is called mucociliary clearance (MCC). Primary ciliary dyskinesia (PCD) is a genetic disease characterized by abnormal ciliary structure and function with impaired MCC leading to frequent respiratory tract infections. A number of inhalation of agents have been proposed as effective treatment options in the literature aiming to increase MCC in PCD patients. These include l-Arginine, as the substrate of nitric oxide (NO) synthases to increase cilia beat frequency and uridine-5 ′ -triphosphate (UTP), which acts to stimulate Cl- secretion and mucin release by goblet cells.

In the present work, we aim to develop an in-silico model of mucociliary clearance for PCD patients and to use this computational platform to explore the inhalation of pharmaceutical agents for the treatment of PCD symptoms. For this purpose, we will use ex vivo visualization data available at RespiHub and its network of collaborators to develop patient-customized models of ciliary motion for pre-selected PCD variants.

After validating the in-silico model against available patient data, we plan to explore the effects of rheological, anatomic and aerosol characteristics on the effectiveness of inhaled pharmaceutical agents in support of MCC in these PCD patients.

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