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The fate of inhaled aerosols in health and disease: insights from in-silico modeling

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The lungs are a prime target for airborne particulate matter exposure and for the delivery of drugs to treat respiratory disorders such as asthma and COPD. The therapeutic and/or adverse health effects of aerosols not only depend upon the characteristics of the particles being inhaled but also upon the site and extent of deposition in the respiratory tract. This talk will review the main mechanistic and physiological factors affecting the transport and deposition of inhaled aerosols in the human lung, discuss recent efforts by Dr. Darquenne's team in the development of in-silico models of aerosol dosimetry, and highlight how these models can provide additional insights in the potential health hazard of airborne particulate matter and/or in the design and development of new inhaled drugs.

Chantal Darquenne is a Professor in the Division of Pulmonary, Critical Care and Sleep Medicine at the University of California, San Diego (UCSD) and the former President of the International Society of Aerosols in Medicine (ISAM, 2019-2021). She earned her Ph.D. degree in Applied Sciences from the Université Libre de Bruxelles (Belgium) in 1995 and completed a postdoctoral fellowship in the Division of Physiology at UCSD. Dr. Darquenne serves as a member of the editorial board of the Journal of Aerosol Medicine and Pulmonary Drug Delivery, the Journal of Aerosol Science and the Journal of Applied Physiology. Her research and publications have focused on the fate of inhaled aerosols in the human lung with applications both in toxic effects of airborne particulate matter and in therapeutic effects of inhaled pharmaceutical aerosols, and also on lung ventilation inhomogeneities in health and disease. Her major research contributions in the field include the study of aerosol inhalations in humans in altered gravity, the development of numerical models that simulate the transport and deposition of aerosols in the lung, the effect of lung disease on both regional and overall aerosol deposition, and the study of upper airway dynamics during breathing and its effect on aerosol transport. Her research is mainly funded through awards and contracts with the National Institute of Health (United States) and with the US Environmental Protection Agency. In 2023, Dr. Darquenne received the Thomas T Mercer Award from the American Association of Aerosol Research and the International Society of Aerosols in Medicine, recognizing her international research excellence in pharmaceutical aerosols and inhalable materials