



Helping people
breathe better
and live fuller lives.

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The Impact of Inhalation Delay on Lung Drug Delivery: Using Functional Respiratory Imaging to Compare Metered Dose Inhaler (MDI) and MDI + Valved Holding Chamber (VHC) Systems

Rationale

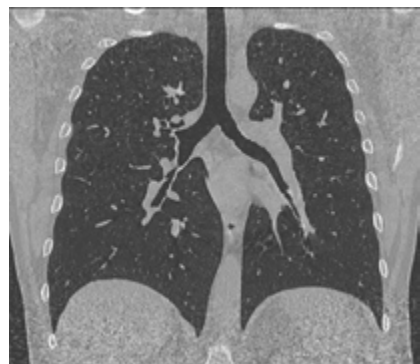
- Evaluations of inhaler use have demonstrated that mishandling of MDIs is commonplace.
 - One of the most common errors is the failure to coordinate inhalation with actuation of the inhaler.
 - One of the reasons why VHCs are often prescribed, is to reduce the severity of this error.
 - This Functional Respiratory Imaging (FRI) based study assessed the likely severity of a short inhalation delay (from actuation) with an MDI alone and how it contrasted to the use with a VHC.
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Methods

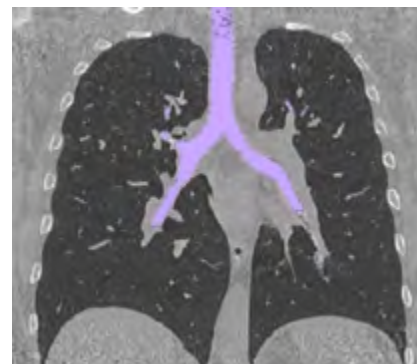
- Three dimensional geometries of airways and lobes were extracted from a CT scan of a 67 year old male COPD Stage III patient.
- Drug delivery and airway deposition of MDI-delivered albuterol (Ventolin⁺-HFA, 100 mcg) was modelled using FRI with measured particle and plume characteristics with and without an **AeroChamber Plus* Flow-Vu*** VHC.
- For the MDI alone, in addition to the 'perfect' 0-second delay, a short inhalation delay of 0.5 seconds was evaluated.
- For the MDI/VHC system, a typical 2-second delay was evaluated.

FUNCTIONAL RESPIRATORY IMAGING



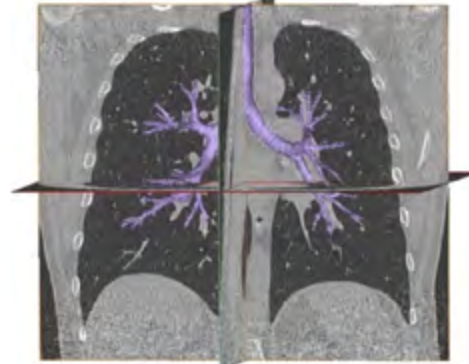
HRCT

1. Patient data is obtained by taking low dose CT scans.



Structure segmentation

2. Patient-specific airway and lung structures are extracted.



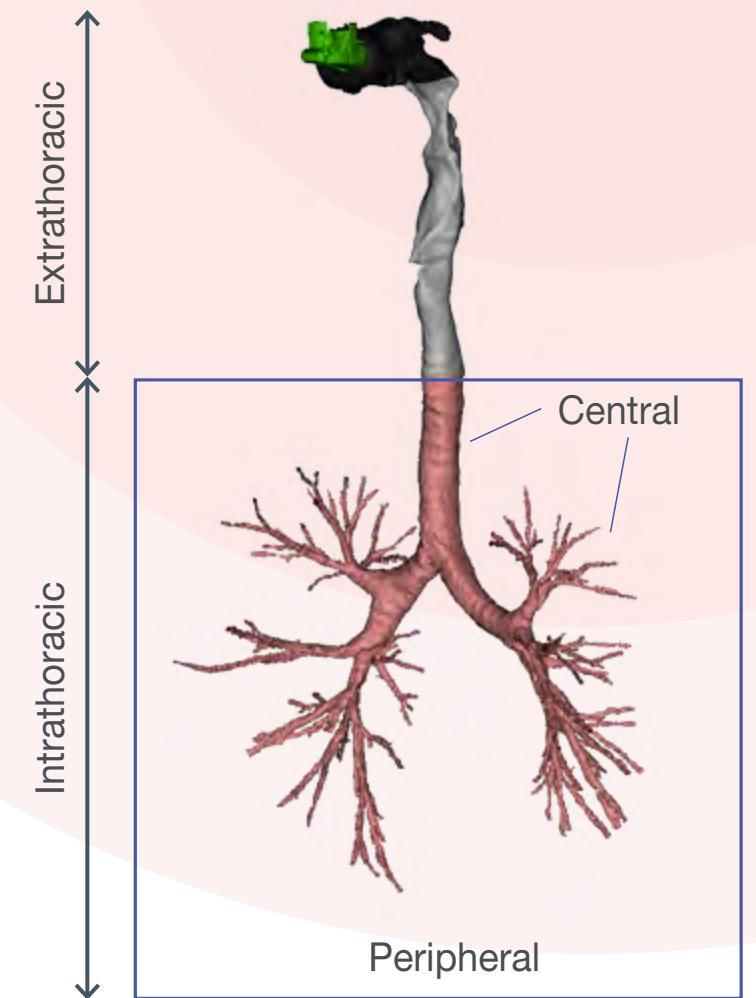
Patient-specific 3D Model

3. Flow and particle simulations are applied to the 3D models.

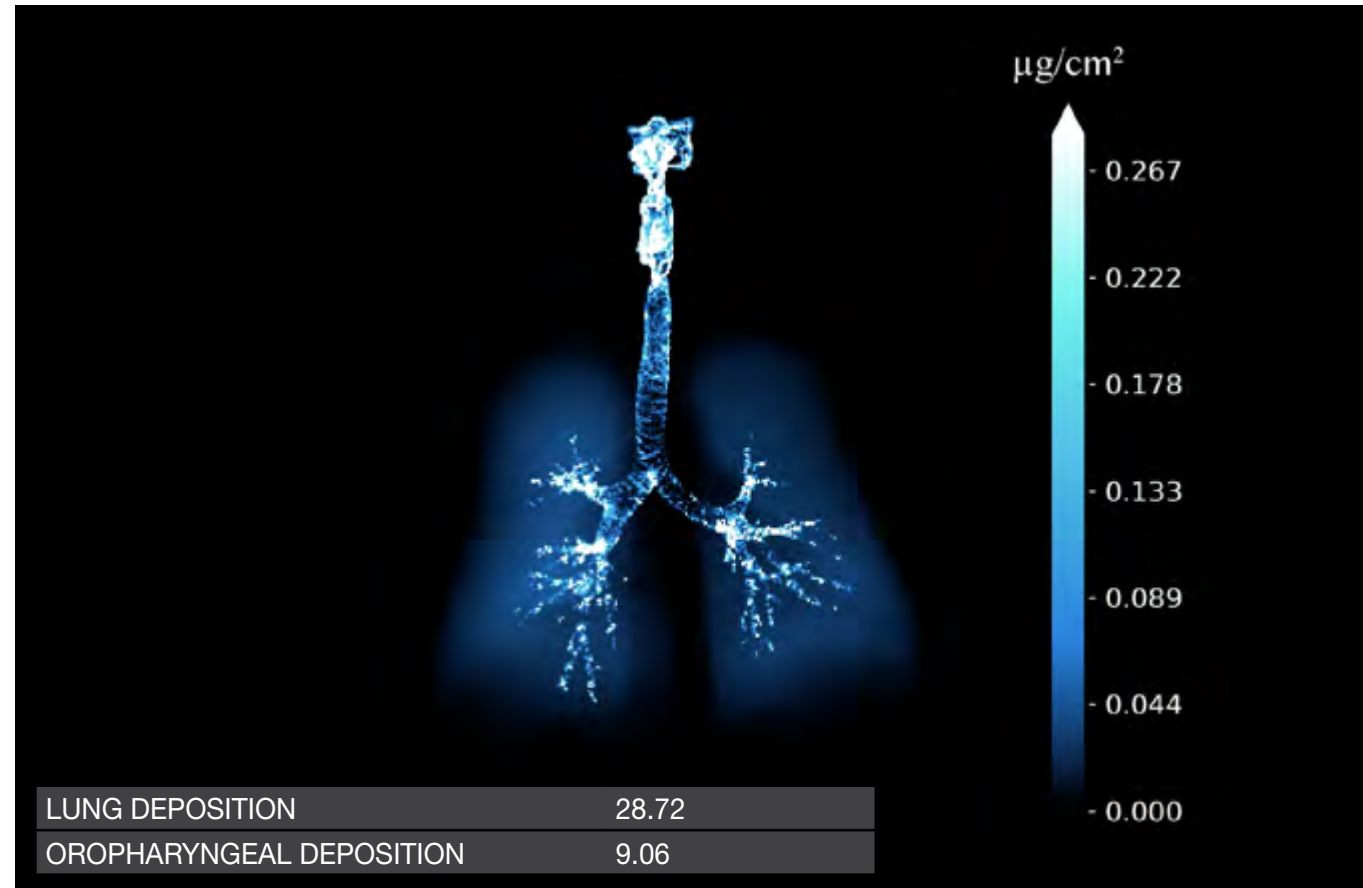


Flow simulation (CFD)

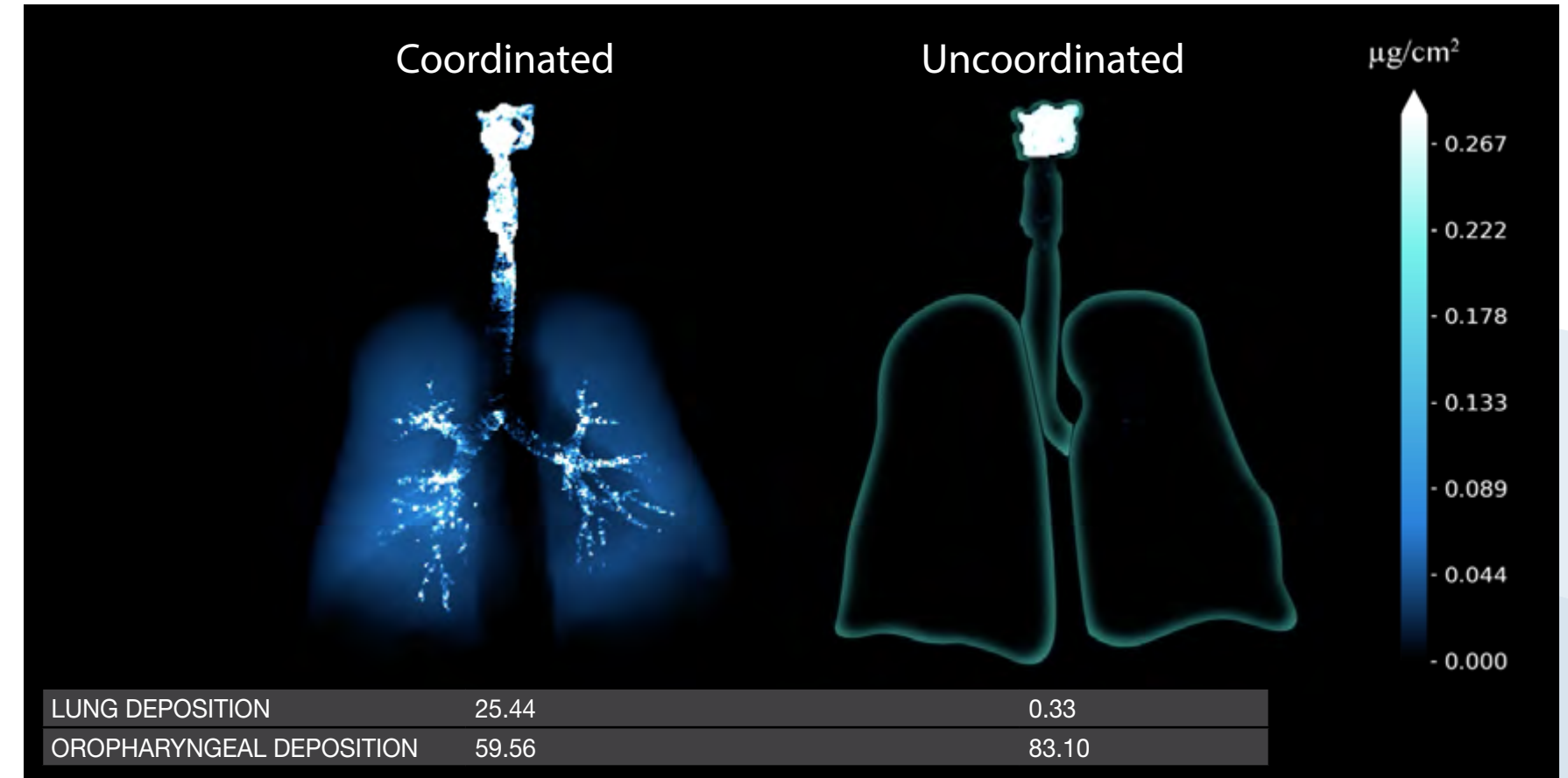
LUNG STRUCTURES AND ZONES



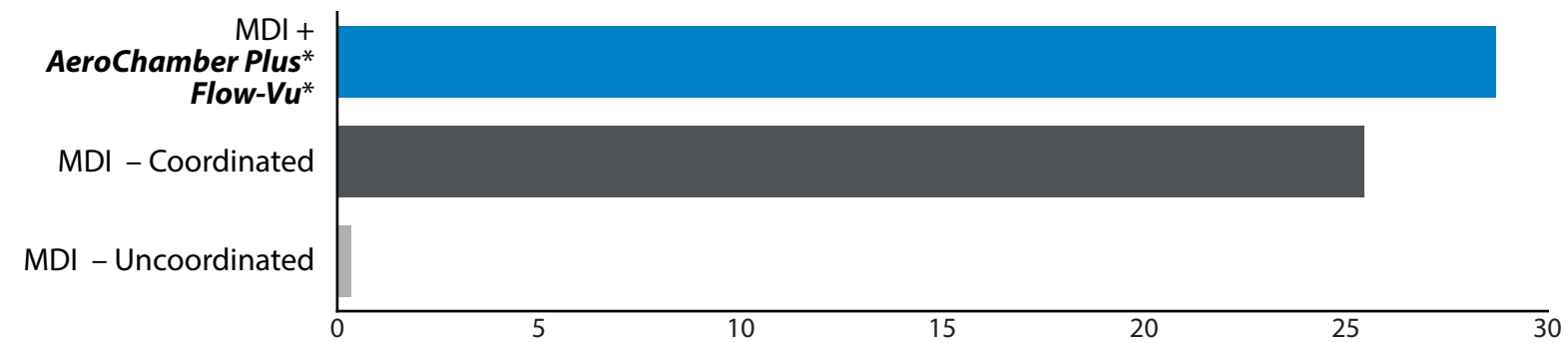
AEROCHAMBER PLUS* FLOW-VU* VHC



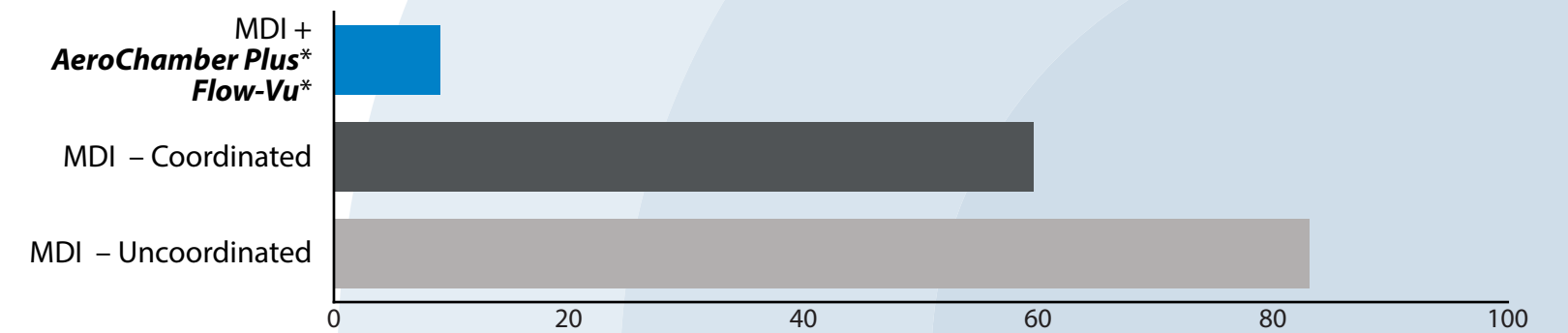
VENTOLIN[†] pMDI



LUNG DEPOSITION



OROPHARYNGEAL DEPOSITION



Conclusion



- The FRI deposition profiles highlight the significant negative impact on lung deposition of even a relatively short 0.5 second delay between actuation and inhalation when an MDI is used alone.
 - The intrathoracic lung delivery decreased from 25.4mcg to 0.3mcg.
 - Extrathoracic delivery (related to oropharyngeal deposition) was consequently even higher.
 - The MDI / **AeroChamber Plus* Flow-Vu*** VHC system with a 2 second delay delivered 28.7 mcg to the intrathoracic region with a greater central lung delivery than the MDI alone (perfect coordination) which might be suggestive of greater delivery to beta adrenoreceptors.
 - These results further the message that the use of an appropriate VHC should be considered as general practice for all people using MDIs other than those with a highly proficient inhaler technique.
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