

# Use of Inspiratory Profiles from Patients with Chronic Obstructive Pulmonary Disease (COPD) to Investigate Drug Delivery from a Passive Dry Powder Inhaler (DPI) Compared with a Pressurized Metered Dose (pMDI) Inhaler with Valved Holding Chamber (VHC)

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- With COPD progression and reduced respiratory muscle strength, patients may generate insufficient inspiratory effort to effectively use DPIs<sup>(a,b)</sup>
- Patients can inhale slowly or breathe tidally from pMDI with VHC without the need to coordinate with inhaler actuation<sup>(c)</sup>

a. *Global Strategy for the Diagnosis, Management and Prevention of COPD*, Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2020. [Last accessed on 2020 Jan 10]  
Available from:  
<https://goldcopd.org/wp-content/uploads/2019/12/GOLD-2020-FINAL-ver1.2-03Dec19-WMV.pdf>

b. Price D, Bosnic-Anticevich S, Briggs A, Chrystyn H, Rand C, Scheuch G, Bousquet J. *Inhaler competence in asthma: Common errors, barriers to use and recommended solutions*. *Respir Med* 2013; 107(1): 37-46

c. Mc Ivor RA, Devlin HM, Kaplan A: *Optimizing the Delivery of Inhaled Medication for Respiratory Patients. The Role of Valved Holding Chambers*. *Can Respir J*. 2018: Article ID 5076259



# Materials and Methods

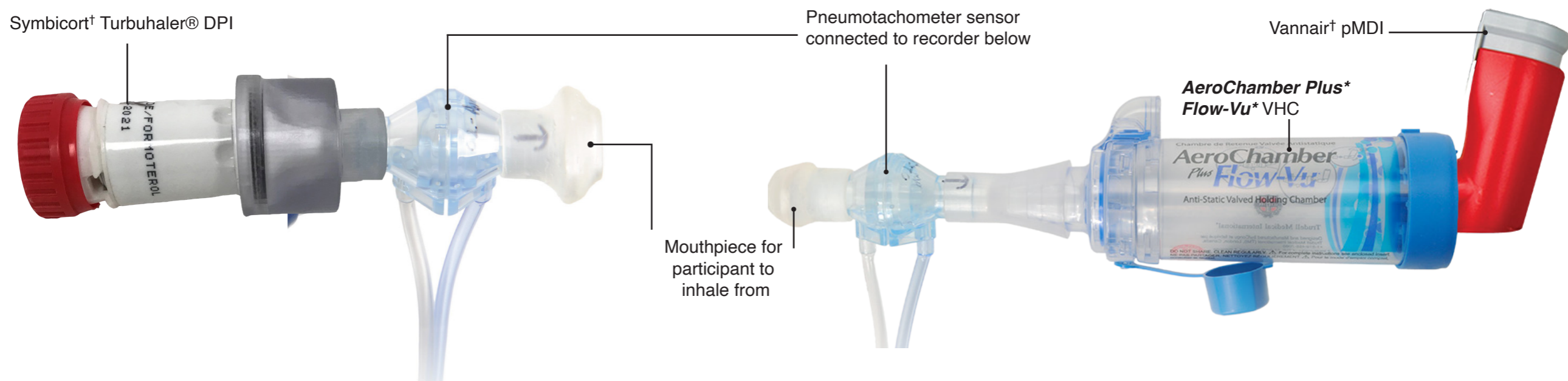


## Inhalation Evaluation

- Compared dose delivery characteristics via inspiratory flow profiles for patients with varying severity of COPD, using a purpose-constructed attachment to a pneumotachometer
- The participants were recorded when using a medium inspiratory flow resistance DPI compared with inhalation of the same active pharmaceutical ingredients (APIs) inhaled via a pMDI + VHC

# Materials and Methods

- The inhalation profiles were subsequently recreated via a breathing simulator (ASL 5000, Ingmar Medical), coupled to the mouthpiece of the appropriate inhaler (DPI or pMDI + VHC) via the adult Aerosol Delivery to Anatomic Model (ADAM)<sup>(d)</sup>.
- The breathing simulator was located distal to a microbial collection filter, positioned at the exit of the oropharynx, to capture medication likely to have deposited at the carinal region and therefore potentially available for delivery to the lungs.



# Results

- The mass of budesonide (BUD) and of formoterol fumarate (FF) recovered from the model oropharynx (O-P) and filter (CARINA) from each simulation (n = 3 replicate measurements), are summarized in Figures 1 and 2 for the DPI (Figures 1A and 2A) and pMDI + VHC (Figures 1B and 2B) modalities

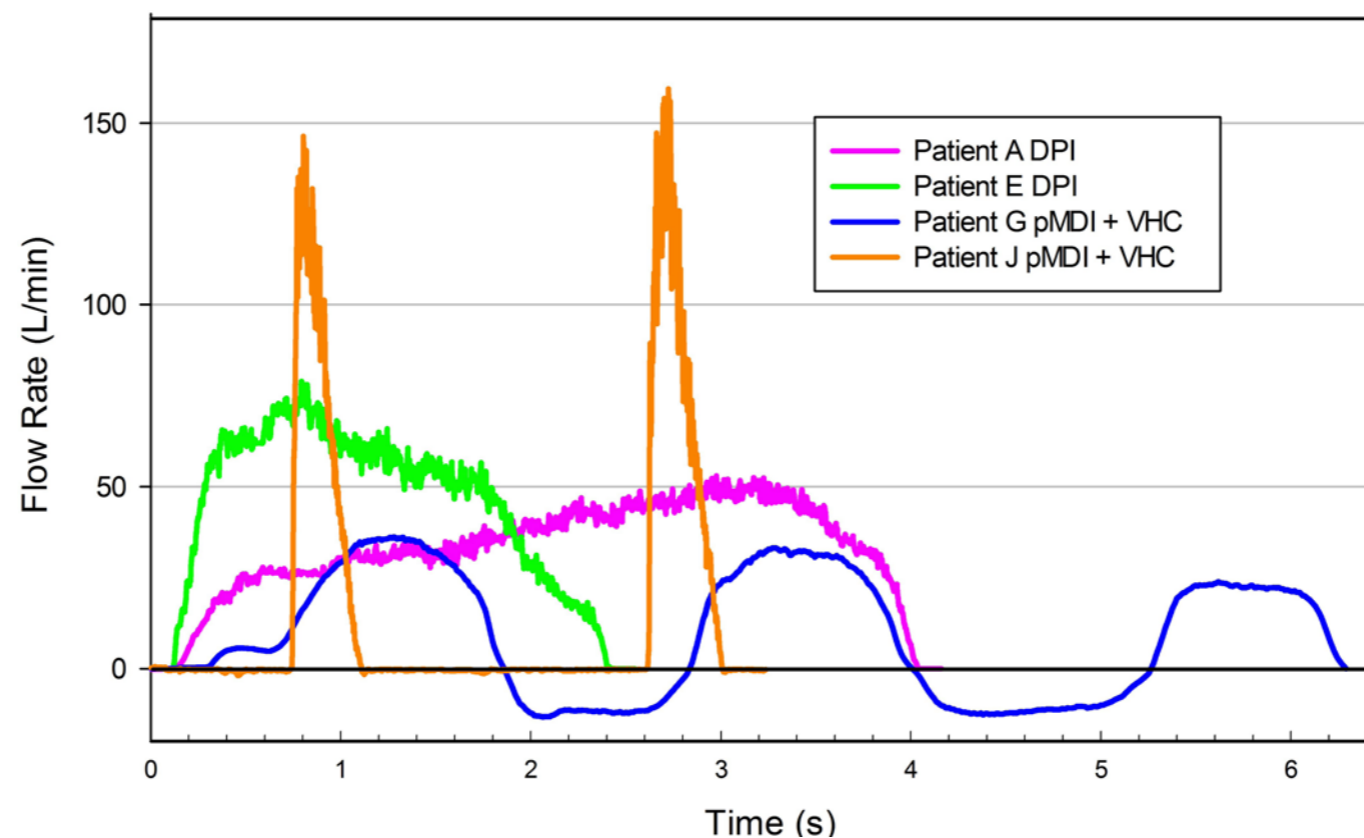
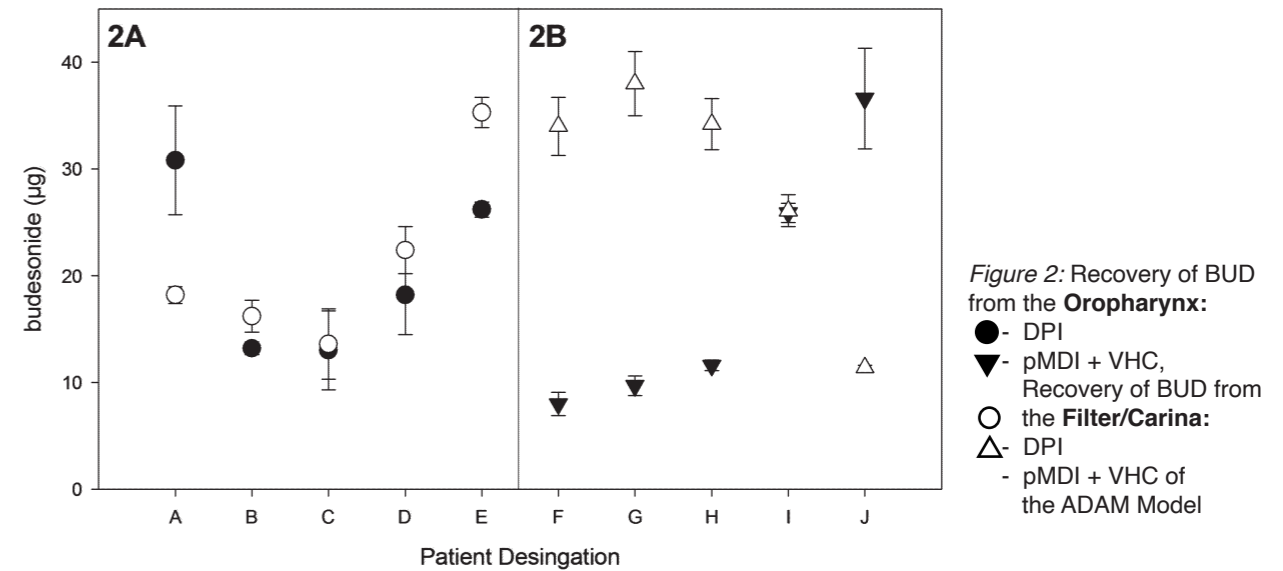
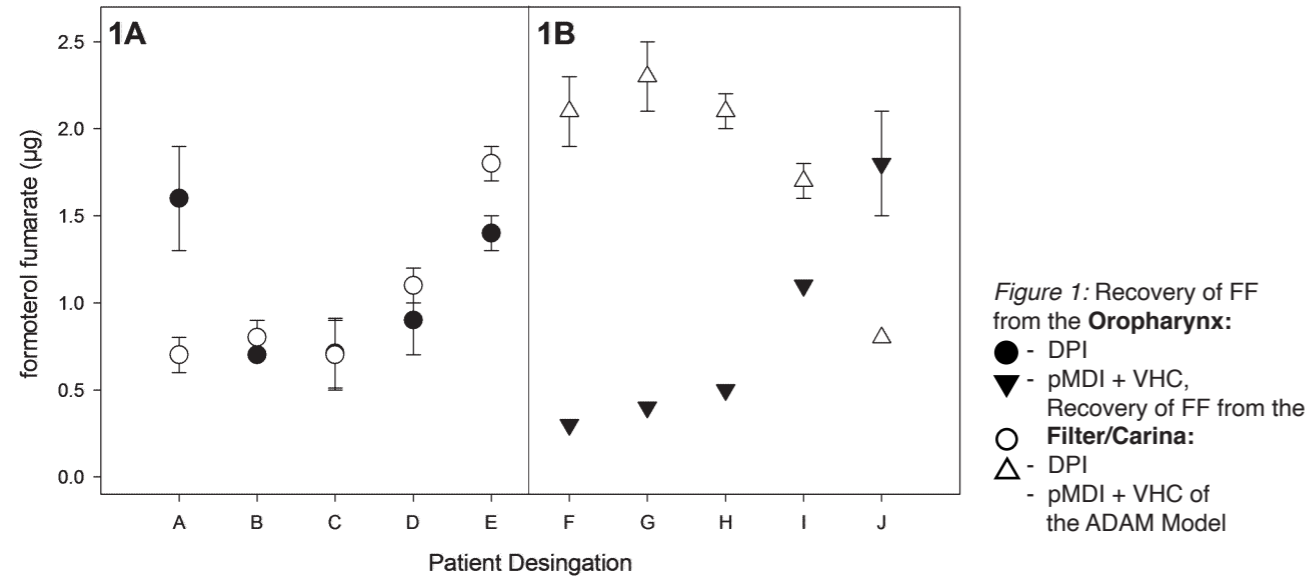
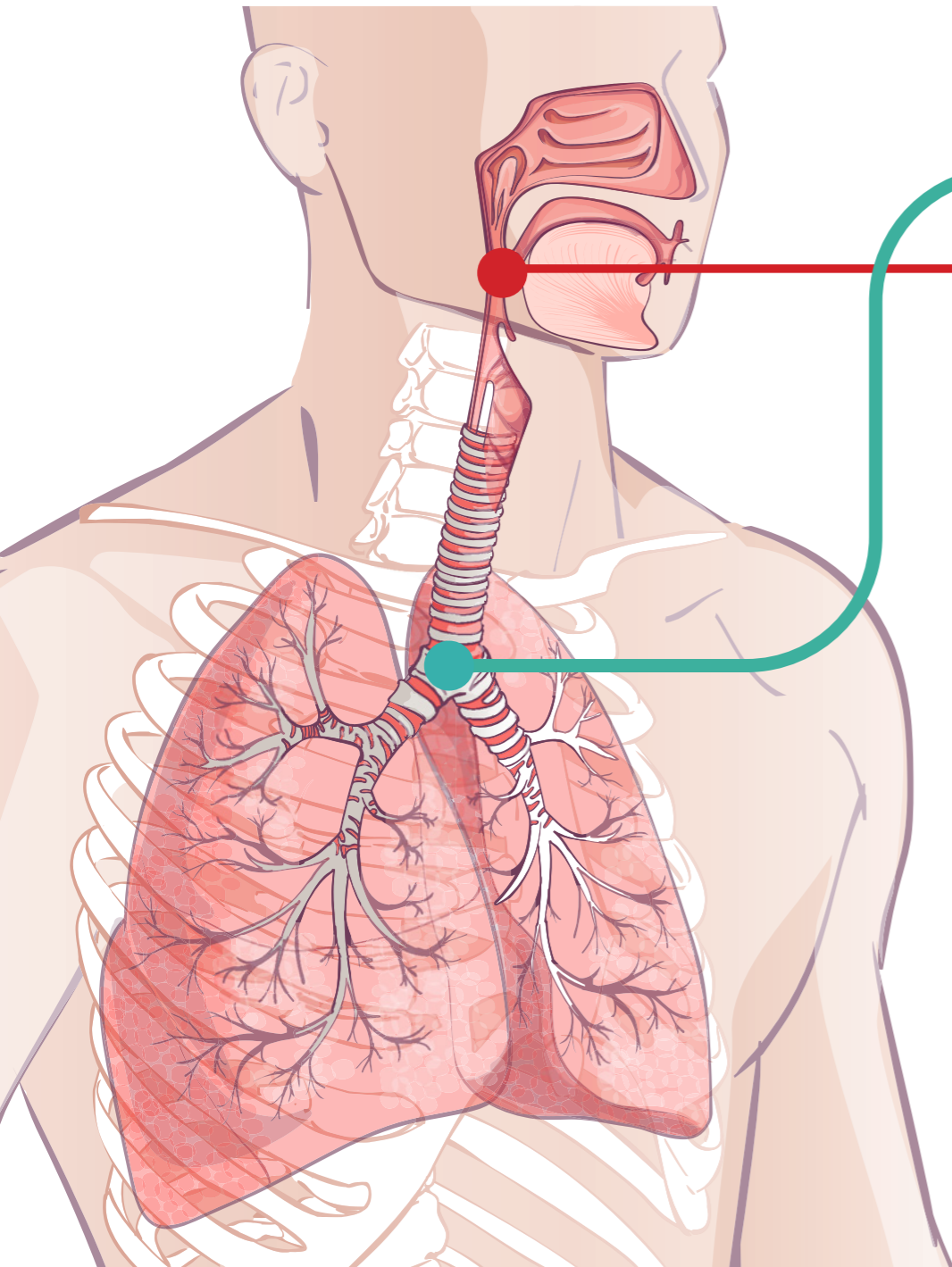


Figure 3: Examples of Inhalation Profiles Recorded from Patients Using Either the DPI or pMDI + VHC

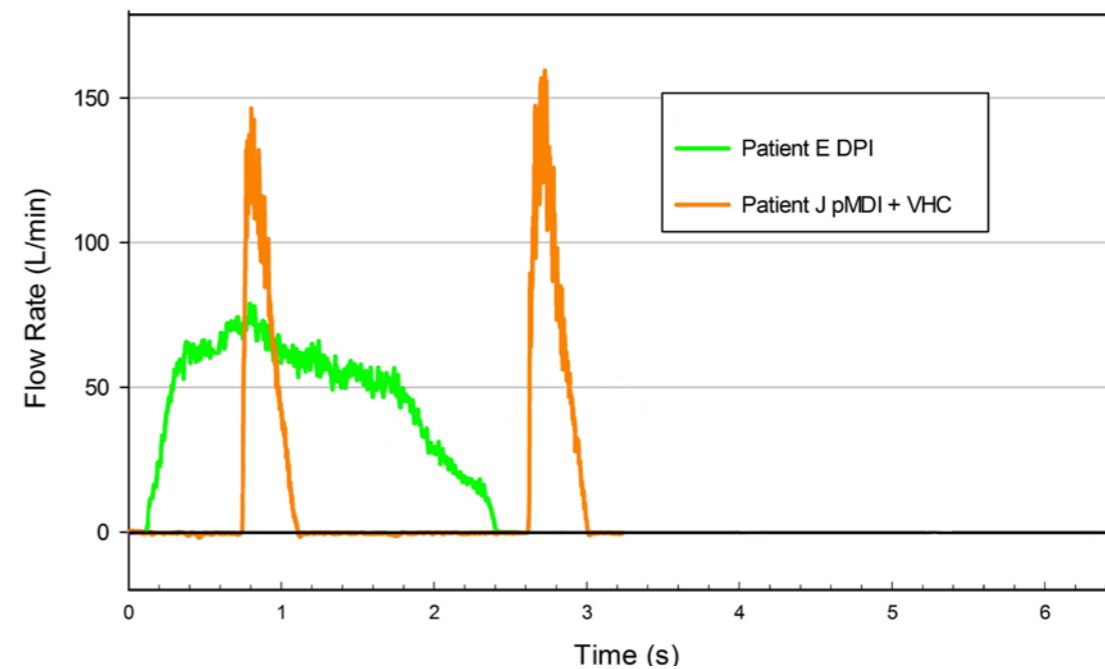
# Discussion



Oropharynx

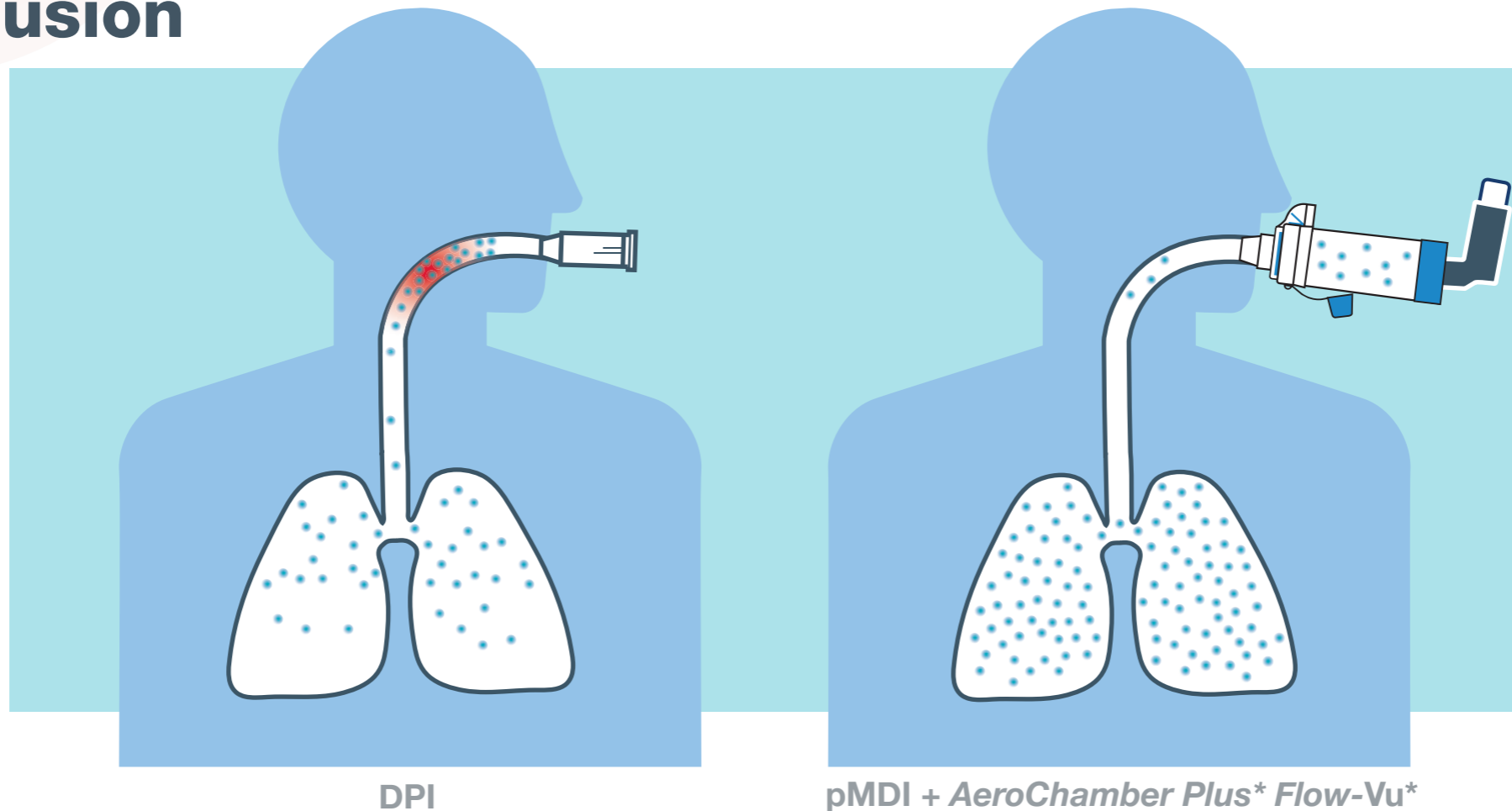
CARINA

- Less oropharyngeal deposition was generally exhibited using the pMDI + VHC. It was notable that the corresponding mass of APIs recovered from the CARINA region when the pMDI + VHC was simulated, was significantly greater than the outcomes obtained by simulating the DPI profiles ( $p \leq 0.03$ )



- **Inhalation profiles vary greatly:** Patient E (DPI) generated sufficient flow enabling similar quantities of API to be delivered to the filter/carina. Patient J (pMDI + VHC) demonstrated high flow rates and reduced inhalation times, resulting in increased deposition in the oropharynx and less in the carina.

## Conclusion



DPI

pMDI + AeroChamber Plus\* Flow-Vu\*

- The pMDI + VHC option can deliver more medication than the particular DPI to the carinal region which is therefore, potentially available for lung delivery
- For patients who cannot fully empty the DPI reservoir, the pMDI + VHC should be considered
- Severe COPD patients using DPIs are likely to receive a significantly lower lung dose
- A larger investigation is required to confirm these results, however, if disease severity can be linked to delivered mass, then the implications are similar to those of Farkas in that severe COPD patients using DPIs are likely to receive a significantly lower lung dose<sup>(e)</sup>. Other DPI devices and disease states should also be evaluated to add more weight to these findings.

e. Nagel MW, Suggett JA, Coppolo DP, Mitchell JP: *Development and evaluation of a family of human face and upper airway models for the laboratory testing of orally inhaled products*. APS PharmSciTech 2017, 18(8): 3182–3197

<https://www.trudellmed.com/rdd-2020-eposter-2>