

A Prototype Continuous Nebulizer Offers Clinicians Short Treatment Times Combined with High Respirable Dose for Efficient Lung Delivery: A Comparative Laboratory Study

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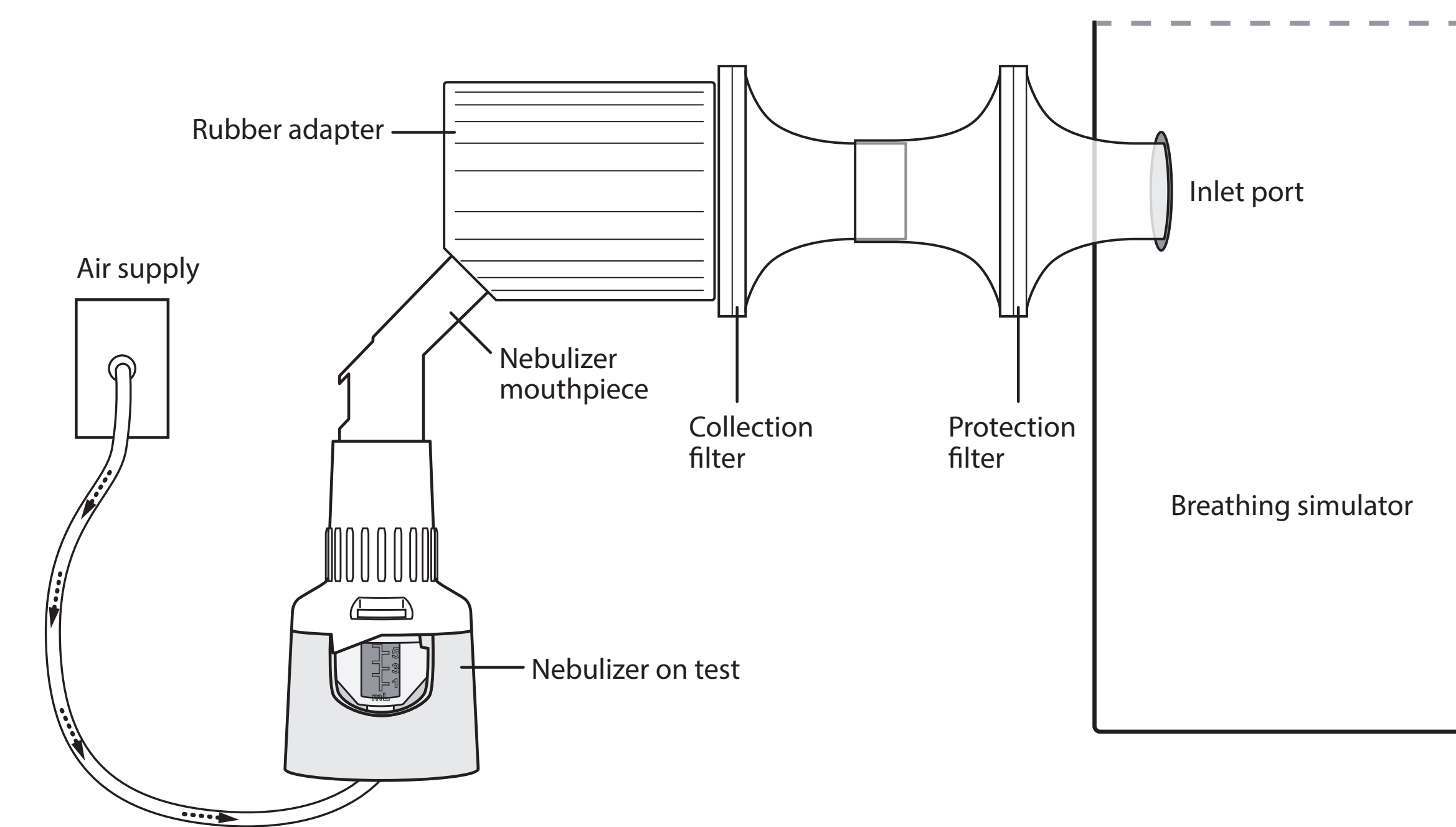
RATIONALE

- The ability to provide rapid inhaled bronchodilator therapy by nebulizer is important for quick relief of obstructive airway symptoms in emergency care and the general hospital environment
- This study compared a continuous jet nebulizer (MMC Continuous, in development), with other continuous jet nebulizers available in the USA

MATERIALS & METHODS



- Each group ($n=5$) was operated with compressed air at 50 psig with a 3 mL fill volume (833 $\mu\text{g/mL}$ albuterol sulfate)



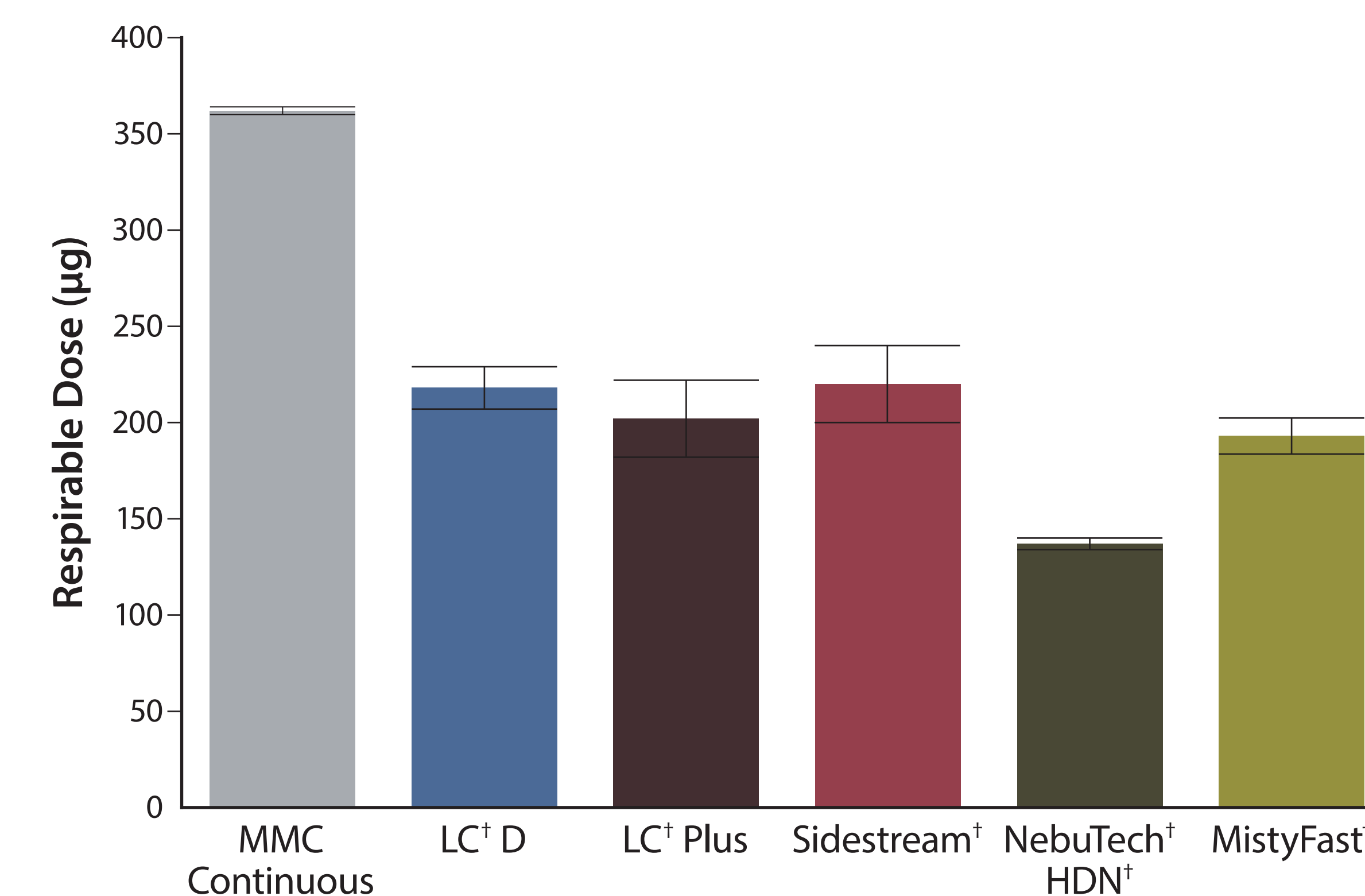
- A breathing simulator was set to mimick an adult tidal breathing pattern
 - Tidal volume = 600 cc
 - Rate/min = 10 cycles
 - Inspiratory:Expiratory ratio = 1:2
- A filter was replaced minute-by-minute at the mouthpiece to capture the Total Mass (TM) until sputter
- Albuterol recovered was quantified by UV-spectrophotometry
- In a parallel study, Respirable Droplet Fraction ($\text{RDF}_{<4.7\mu\text{m}}$) was determined by laser diffractometry representing Respirable Dose (RD)
- Respirable Droplet Mass ($\text{RDM}_{<4.7\mu\text{m}}$) was calculated as $\text{TM} \times \text{RDF}_{<4.7\mu\text{m}}$, and mean Respirable Dose delivery rate (mean RD rate) was the product of RD and $\text{RDF}_{<4.7\mu\text{m}}$ divided by treatment time

RESULTS

In Vitro Characterization of the Delivery of Albuterol Sulfate Solution (833 $\mu\text{g/mL}$) with Adult Tidal Breathing Pattern from Continuous-Delivering Pneumatic Nebulizers

Device	MMAD (μm)	$\text{RDF}_{<4.7\mu\text{m}}$ (%)	TM (μg)	Treatment Time (mins)	RD (μg)	Mean RD Rate ($\mu\text{g}/\text{min}$)
MMC Continuous	2.5 \pm 0.0	82 \pm 1	443 \pm 3	4	362 \pm 2	90.5
LC+D	2.4 \pm 0.1	81 \pm 1	269 \pm 13	3	218 \pm 11	72.7
LC+Plus	2.9 \pm 0.1	75 \pm 2	271 \pm 27	3	202 \pm 20	67.3
Sidestream†	3.1 \pm 0.2	72 \pm 3	30 \pm 28	6	220 \pm 20	36.6
NebuTech† HDN†	5.8 \pm 0.1	40 \pm 1	347 \pm 7	3	137 \pm 3	45.7
MistyFast†	3.7 \pm 0.2	63 \pm 3	307 \pm 15	4	193 \pm 9	48.3

Respirable Dose (RD) of Albuterol Sulfate Solution (833 $\mu\text{g/mL}$) with Adult Tidal Breathing Pattern



- The MMC Continuous nebulizer (in development) produced droplets with MMAD of 2.5 \pm 0.0 μm , and $\text{RDF}_{<4.7\mu\text{m}}$ of 82 \pm 1%
- The treatment time for the MMC Continuous (4 mins) was comparable to the other nebulizers, with the exception of the Sidestream† (6 mins)
- RD and RD Rate was highest for the MMC Continuous nebulizer, at 362 μg and 90.5 $\mu\text{g}/\text{min}$ respectively

CONCLUSIONS

- The MMC Continuous (in development) nebulizer produced a high output rate of fine droplets, with short delivery time
- This new device will afford the clinician the benefits of rapid treatment times with a high respirable dose to optimize lung delivery

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