

How aerosol plumes differ by inhaler type: a study of COPD maintenance therapies

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Supplementary material

Table S1. Mean aerosol velocity and spray duration at all experimental flow rates.

Product	Device	Optimal experimental flow rate (L/min)	Mean inhaler resistance (sqrt(mbar) *min/L)	Air flow rate (L/min)	Mean velocity at 10cm from mouthpiece (m/s), $\pm$ SD	Mean duration of plume (ms), $\pm$ SD	Aerosol density evenness ^c	Cross section of mouthpiec e (mm ²)	Calculate	Conventional air flow resistance (sqrt(mbar)* min/L) ^d	Conventional optimal experimental flow rate (L/min) ^d
									d mean velocity at exit cross section (m/s)		
Spiolto Respimat	SMI	30	0.045	30	0.99 $\pm$ 0.06	1447 $\pm$ 25	Soft mist		1.8	0.037	171 ^d
				60	1.66 $\pm$ 0.12	1457 $\pm$ 25	Thin cloud	283	3.5		
				90	2.63 $\pm$ 0.50	1420 $\pm$ 10	Very thin cloud		5.3		
Bevespi Aerosphere	pMDI	30	0.026	30	3.65 $\pm$ 0.52	253 $\pm$ 6	Pronounced front		1.8	0.017	372 ^d
				60	4.77 $\pm$ 0.80	223 $\pm$ 15	Pronounced front	273	3.7		
				90	4.83 $\pm$ 0.82	207 $\pm$ 12	Pronounced front		5.5		
Trimbow	pMDI	30	0.033	30	4.30 $\pm$ 0.22	270 $\pm$ 0	Pronounced front		2.0	0.023	275 ^d
				60	4.32 $\pm$ 0.27	273 $\pm$ 12	Pronounced front	256	3.9		
				90	3.75 $\pm$ 0.29	280 $\pm$ 10	Pronounced front		5.9		

Triexo Aerosphere	pMDI	30	0.030	30	5.09 ± 0.11	227 ± 21	Short cloud		1.8	0.017	372 ^d
				60	5.32 ± 0.51	220 ± 10	Short cloud	271	3.7		
				90	4.60 ± 0.17	203 ± 6	Short cloud		5.5		
Anoro Ellipta ^a	DPI	68	0.093	30	1.60 ± 0.14	143 ± 21	Bolus		9.5	0.087	73
				60	2.24 ± 0.12	70 ± 10	Bolus	52.6	19.0		
				90	2.61 ± 0.20	60 ± 17	Bolus		28.5		
Brimica Genuair	DPI	63	0.100	30	1.16 ± 0.08	137 ± 15	Bolus + cone		13.0	0.102	62
				60	1.64 ± 0.04	163 ± 32	Bolus + cone	38.5	26.0		
				90	1.90 ± 0.06	153 ± 6	Bolus + cone		39.0		
Trelegy Ellipta ^a	DPI	84 ^b	0.075	30	1.86 ± 0.08	73 ± 6	Bolus		9.5	0.085	74
				60	2.13 ± 0.01	60 ± 10	Bolus	52.6	19.0		
				90	3.32 ± 0.37	47 ± 6	Bolus		28.5		
Trimbow NEXThaler	DPI	54	0.118	30	1.74 ± 0.09	63 ± 6	Bolus + cone		9.7	0.114	55
				60	1.43 ± 0.20	100 ± 0	Bolus + cone	51.5	19.4		
				90	1.75 ± 0.13	167 ± 6	Bolus + cone		29.1		
Ultibro Breezhaler	DPI	90	0.070	30	2.30 ± 0.10	1213 ± 189	Lengthy cloud		5.7	0.073	87
				60	3.58 ± 0.18	750 ± 66	Lengthy cloud	88.2	11.3		
				90	4.60 ± 0.96	757 ± 410	Lengthy cloud		17.0		

Note: Each product tested was from the same batch with the same expiry date.

^aEllipta devices generated different optimal experimental flow rates due to a manufacturing difference in the mouthpiece (flush or with air gap). ^bThe design of the Trelegy Ellipta device influences its resistance depending on experimental set-up with optimal experimental flow rate considered closer to 60 L/min than 90 L/min. ^cDescriptive only; please refer to video of inhaler plumes (supplementary file). ^dConventional refers to pharmacopoeial testing methods where air is sucked into an adapter and a filter connected to a vacuum pump. ^dPharmacopoeial testing request 30 L/min as testing flow rate.

DPI, dry powder inhaler; pMDI, pressurised metered-dose inhaler; SD, standard deviation; SMI, soft mist inhaler; sqrt, square root.