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Title: Improving inhalation parameters through dry powder inhalers (DPIs) after an acute asthma exacerbation

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Body: All DPIs are passive inhalers because they require the generation of an internal energy (P) from an interaction between the patient's inhalation and the device's resistance to deaggregate the formulation in the metered dose. During acute exacerbations patient inspiratory effort will be reduced and thus P will be reduced. We have measured the inhalation profiles of 18 asthmatics, mean(SD) age 42.0(11.8) years, on days 1-4 following their admission with an acute exacerbation. These measurements have been made using a Diskus (DKS), Easyhaler (EASY) and Turbuhaler (TBH) - inhalers with medium, medium/high and high resistance.

	Day 1	Day 2	Day 3	Day 4
FEV_1% pred	40.9(12.5)	47.9(13.6)	55.6(12.6)	58.2(11.8)
DKS				
PIF (L/min)	42.3(8.9)	51.0(8.7)	65.7(16.0)	77.0(15.4)
PP (kPa)	1.60(0.74)	2.28(0.83)	3.91(2.07)	5.27(2.10)
ACC (KPa/sec)	2.31(1.38)	3.63(2.49)	6.72(3.68)	10.26(8.21)
IV (L)	0.80(0.34)	0.90(0.30)	1.11(0.36)	1.35(0.31)
TBH				
PIF (L/min)	35.1(4.9)	41.4(5.60)	45.3(6.3)	50.9(7.2)
PP (kPa)	1.42(0.41)	1.98(0.52)	2.38(0.66)	3.00(0.83)
ACC (KPa/sec)	2.55(1.12)	4.29(2.12)	4.53(1.71)	6.23(3.06)
IV (L)	0.55(0.25)	0.64(0.29)	0.72(0.26)	0.84(0.26)
EASY				
PIF (L/min	31.3(3.7)	38.3(4.7)	43.3(6.5)	48.2(7.6)
PP (kPa)	2.33(0.53)	3.51(0.85)	4.52(1.35)	5.59(1.74)
ACC (KPa/sec)	4.60(1.78)	6.94(2.32)	9.06(3.77)	11.15(4.91)

IV (L)	0.53(0.18)	0.63(0.17)	0.77(0.26)	0.86(0.34)

PIF - peak inhalation flow; PP - peak turbulent energy; ACC - initial acceleration of the inhalation; IV - inhalation volume. All $p<0.001$ except TBH IV <0.05

All parameters improved. PIF should not be considered in isolation and provides the wrong message, especially for high resistance DPIs, as PP and ACC are more important. The significance of the IV results needs to be investigated.