How Does Watching an Instructional Video Affect Inhalation Technique with a Dry Powder Inhaler? A Small-Scale Scoping Study with Adult Volunteers Naïve to Dry Powder Inhaler Use

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INTRODUCTION

- The ability of a patient to inhale forcefully for a given period of time is a prerequisite for effective medication delivery from passive Dry Powder Inhalers (DPIs).
- Studies investigating patient compliance have repeatedly observed that maintaining a consistent inhalation technique is difficult for many users. On-line video instruction tutorials have been developed by pharmaceutical and patient advocate organizations as one of several routes to assist patients in this respect.
- The present scoping study was designed to examine the issue with adult volunteers using the widely prescribed Diskus† passive DPI (GSK Inc., Canada).

MATERIALS AND METHODS

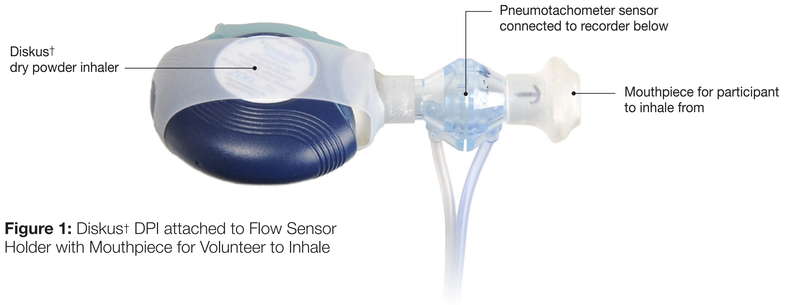

Figure 1: Diskus† DPI attached to Flow Sensor Holder with Mouthpiece for Volunteer to Inhale

- A Ventolin† Diskus† DPI was modified to prevent delivery of medication by taping the dose release lever to the body of the inhaler.
- Three DPI naïve adult volunteers were asked to inhale from an open DPI
- After being told to inhale "quick and deep", the volunteer received no further instruction before inhaling from the DPI mouthpiece to obtain the "untrained" inspiratory maneuver.
- The volunteer was then asked to watch an on-line video describing the correct use of the Diskus† DPI, and the "trained" inspiratory flow profile was recorded
- The recorded "untrained" and "trained" inspiratory flow rate waveforms were recreated by a breathing simulator (ASL 5000, Ingmar Medical) coupled to the mouthpiece of an Advair† Diskus† DPI (250 µg Fluticasone Propionate (FP) + 50 µg Salmeterol Xinafoate (SX)).
- The resulting aerosol particle size distribution (APSD) was size-analyzed by a Next Generation Impactor (NGI) equipped with pre-separator, and operated at 60 L/min.
- A compressed air source and Nephele mixing inlet was used to enable the impactor to operate at constant flow rate throughout the measurement process.
- The DPI was attached to a pneumotachometer (SpiroQuant H flow sensor, EnviteC-Wismar GmbH) with a purpose-made fitting and also equipped with a mouthpiece, constructed to the same geometry as the inhaler to avoid any difference in the patient interface, from which the volunteer inhaled (Figure 1).
- The inspiratory flow rate-elapsed time profile was recorded at 200 Hz (SmartLab†).

RESULTS

Figure 2: Recorded Inspiratory Flow Patterns

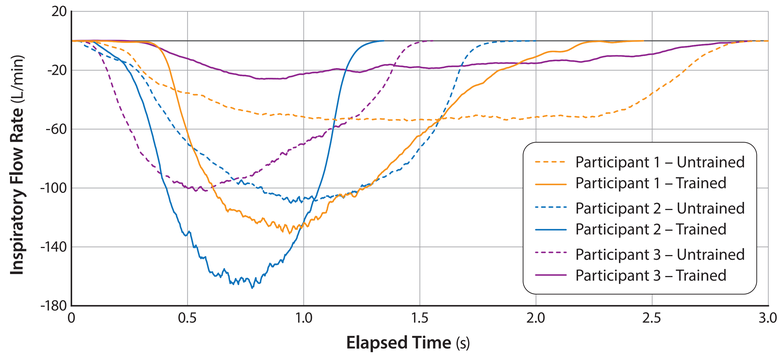

Table 1: Total Inhalation Volume, Peak Inspiratory Flow Rate (PIFR) for each recording

Participant Number	Condition	Inhalation Volume (mL)	PIFR (L/min)
1	untrained	1872	52.5
	trained	2099	125.7
2	untrained	1951	107.8
	trained	1876	163.0
3	untrained	1522	100.3
	trained	621	25.7

Table 2: Key parameters derived from APSD measurements by NGI

Participant ($n=5$)	Parameter	Untrained		Trained	
		FP	SX	FP	SX
1	Total Recovered Mass (µg)	177.7 ± 13.5	34.7 ± 3.2	192.5 ± 11.5	36.9 ± 1.7
	ISF<12.8 µm (%)	88.1 ± 1.7	88.3 ± 0.7	86.7 ± 1.5	87.3 ± 1.4
	FPF<4.5 µm (%)	23.7 ± 2.1	20.4 ± 2.1	21.0 ± 0.9	18.7 ± 0.6
	FPM<4.5 µm (µg)	42.4 ± 6.6	7.1 ± 1.3	40.3 ± 1.0	6.9 ± 0.1
2	Total Recovered Mass (µg)	236.4 ± 43.1	46.8 ± 9.1	197.3 ± 7.1	39.6 ± 2.6
	ISF<12.8 µm (%)	90.1 ± 1.8	90.7 ± 1.8	90.0 ± 0.5	90.8 ± 0.5
	FPF<4.5 µm (%)	20.4 ± 2.7	17.6 ± 2.5	16.1 ± 1.1	14.8 ± 2.0
	FPM<4.5 µm (µg)	47.5 ± 4.3	8.1 ± 0.8	31.8 ± 2.4	5.9 ± 1.2
3	Total Recovered Mass (µg)	203.2 ± 31.7	39.8 ± 6.9	112.8 ± 27.4	21.6 ± 5.2
	ISF<12.8 µm (%)	86.6 ± 2.5	87.1 ± 2.6	85.5 ± 2.3	85.9 ± 2.6
	FPF<4.5 µm (%)	20.3 ± 1.3	17.5 ± 1.2	20.9 ± 2.0	18.4 ± 1.7
	FPM<4.5 µm (µg)	41.1 ± 5.0	6.9 ± 0.9	23.6 ± 6.6	4.0 ± 1.2

- The upper size bounds for Impactor-Sized Mass Fraction (ISF), Fine Particle Fraction (FPF) and Fine Particle Mass (FPM) were 12.8 µm, 4.5 µm and 4.5 µm aerodynamic diameter respectively.
- Values of FPF were comparable with 22.9 ± 1.2% (FP) and 19.3 ± 0.9% (SX) reported by Buttini *et al*. (J. Aerosol Med. Pulmon. Deliv. 2016; 29(2):167-178) in terms of particles < 5 µm aerodynamic diameter for Seretide† Diskus† DPIs.

DISCUSSION

- It appears that the training was effective for participants 1 and 2 (Table 1), as their PIFR increased substantially after training, although total inhalation volume remained essentially the same.
- **Participant 1:** Training had little impact on either ISF or FPF associated with either Active Pharmaceutical Ingredient (API) (Table 2). Thus, the same FPM of FP/SX would have been received irrespective of training had this person inhaled the medication.
- **Participant 2:** Surprisingly, they would have received slightly less FPM of either API after training, but the difference may not be clinically significant.
- **Participant 3:** Did the opposite of anticipated behavior post-training, with a substantially reduced PIFR and associated smaller inhalation volume (Table 1). Before training, this volunteer would have received slightly less of either API compared with the others. After training, this participant would have received significantly less FPM in concordance with the reduced inhalation volume.
- Interestingly, powder dispersion of the mass able to be emitted from the device was still effective, given the similar values of both ISF and FPF with all the participants, determined by the NGI, before and after training.

CONCLUSIONS

- The widely differing inspiratory flow profiles in response to training is indicative that use of this particular DPI may not be easy to master for all users after video instruction.
- The observed differences in profiles appeared to be more relevant to emission of powder out of the device as opposed to dispersion of the powder once emitted.
- Further studies are warranted with a larger number of volunteers and also with other passive DPIs.

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