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LETTER

Are we misleading users of respiratory spacer devices?

*Mark J Sanders[1], Ronald Bruin[2]

[1] Managing Director, Clement Clarke International Ltd., Harlow, Essex, UK

[2] Head of New Product Development, Clement Clarke International Ltd., Harlow, Essex, UK

*Correspondence: Mr Mark J Sanders, Clement Clarke International Ltd., Edinburgh Way, Harlow, Essex, CM20 2TT, UK
Tel: +44 (01)279 456 240 Fax: +44 (01)1279 456 300
E-mail: msanders@clement-clarke.com

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Dear Sirs,

The UK Drug Tariff lists a number of spacer and valved holding chamber (VHC) products for use with pressurised metered dose inhalers (pMDIs).[1] These add-on devices have the double objective of improving the delivery of drug, and making the inhalation procedure easier for the patient. VHCs, in particular, help the user by eliminating the requirement that the slow deep inspiration coincides with the actuation of the pMDI – a manoeuvre which can be particularly tricky for children and the elderly, although poor co-ordination is worryingly common in pMDI users irrespective of age.[2]

VHC users should inhale gently, using either tidal breathing or an approximate 30 L/min inspiratory flow, which facilitates lung deposition of the drug particles.[3] Some VHC products include an alert whistle designed to sound "when the patient is breathing in too quickly", as this type of forceful inspiratory manoeuvre increases the likelihood of oral/pharyngeal drug deposition. It is known that healthcare trainers use the whistle-alert as a tool to titrate the patient's respiratory effort.[2,3] Our expectation was, therefore, that VHC whistles would be activated if the patient goes beyond a flow rate of 60 L/min (the top end of the ideal inspiratory flow rate). However, our research with three whistle-containing VHCs suggests that this appears to be an erroneous assumption and, unwittingly, we may be misleading patients and therefore contributing to reduced patient care.

We measured the whistle-activation flow rates for three different makes of VHCs: Able Spacer® (Clement Clarke), AeroChamber Plus® (GSK), and Optichamber Diamond (Philips Respironics). A calibrated waveform generator (Pulmonary Waveform Generator System, MH Custom Design & Mfg L.C., Utah, USA) was used to create a standardised vacuum force similar to a human inhalation. The performance of three samples of each device was assessed when used with a range of popular drug pMDIs (see Table). The vacuum force was repeated at 1 L/min incremental amounts until the VHC-whistle sounded. Two operatives agreed the whistle sounding. Three recordings of each VHC-drug pMDI combination were carried out (n=54 tests) and the flow rates recorded.

The data show that there is a wide variation in the performance of a VHC-whistle as a function of the inhaler to which it is attached. In many instances the whistle first activates at a flow rate well beyond what would be considered acceptable in order to promote effective drug deposition.

This phenomenon can be explained. When the patient inhales from the VHC, air will be drawn in through a combination of two routes – the whistle, and the channels surrounding the canister of

Table 1. VHC-whistle activation flow rates according to attached drug pMDI

pMDI	Trade mark (origin)	Able Spacer (L/min)		AeroChamber Plus (L/min)		Optichamber Diamond (L/min)	
		n=3	mean	n=3	mean	n=3	mean
ipratropium bromide	Atrovent® (Boehringer Ingelheim)	30/27/30	29	30/39/30	33	27/27/24	26
beclometasone dipropionate	Qvar® (IVAX/Teva)	45/39/42	42	51/57/51	53	39/39/39	39
salmeterol xinafoate/ fluticasone propionate	Seretide® Evohaler® (GSK)	48/48/48	48	60/66/60	62	42/42/42	42
beclometasone dipropionate	Clenil® Modulite® (Chiesi)	72/60/60	64	78/87/78	81	60/60/60	60
salbutamol sulphate	Ventolin® (GSK)	96/78/78	84	96/102/96	98	78/75/75	76
fluticasone propionate/ formoterol fumarate	Flutiform® (Jagotec/Napp)	99/90/88	91	126/138/132	132	96/93/93	94

the pMDI. The balance between these routes will dictate the flow at which the whistle sounds. If the pMDI has a relatively high resistance (for example, Atrovent pMDI) it will be easier for air to enter through the whistle and therefore the whistle will sound at a lower flow rate. In the example of a low resistance inhaler (for example, Flutiform pMDI), it will be necessary to reach a high flow rate before there is sufficient negative pressure to cause air to go through the whistle, and thus the patient does not hear the whistle until a high flow rate is achieved.

The performance profile of spacers and VHCs are generally assessed under *in vitro* respiratory laboratory conditions at flow rates of 28.3 L/min, yet the data obtained from this standardised procedure may be very different from the patient situation. Medical practitioners need to be aware that alert-whistles in VHCs do not behave in a universally acceptable manner, and that certain whistle-VHC plus drug pMDI combinations only sound at high inspiratory flows. With this awareness, it becomes inappropriate to conduct training with VHCs on the basis of back-titration from the sound of the whistle alert.

There is also evidence of the misconception that VHC whistles sound if the inspiratory flow exceeds 30 L/min, which is particularly worrying.[4] However, the extent to which the whistle signal has been used erroneously as a criterion of technique in published studies is difficult to determine owing to imprecise summarisation of clinical protocols; nevertheless, investigators may have concluded that patients were inhaling slowly if the whistle did not sound.

If practitioners are prescribing certain VHC-drug pMDI combinations they should be aware of the possibility of poor lung deposition and, potentially, poor disease control. It would be interesting to compare the use of VHC-drug combinations with repeat visits to the practice, as it is already known that patients with poor inhalation technique and drug compliance are more likely to present with exacerbations.[5]

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Conflicts of interest MS is the Managing Director of Clement Clarke International Ltd., the manufacturer of the Able Spacer® device. RB is Head of New Product Development, Clement Clarke International Ltd.

Contributorship MS guarantees that the data are presented as collected. MS and RB were the sources of the idea for the study, which was carried out at the respiratory laboratory facilities of Clement Clarke International Ltd. by Mr Ronald Bruin, Head of New Product Development, and Mr Matthew Hammond, student design engineer.

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References

1. The October 2013 Electronic Drug Tariff - http://www.ppa.org.uk/edt/October%202013.pdf (accessed 8 October 2013)
2. Lavorini F. The challenge of delivering therapeutic aerosols to asthma patients. ISRN Allergy 2013; Article ID 102418. http://dx.doi.org/10.1155/2013/102418
3. Laube BL, Janssens HM, de Jongh FHC *et al.* What the pulmonary specialist should know about the new inhalation therapies. ERS/ISAM Task Force Report. *Eur Respir J* 2011;**37**(6):1308-31. http://dx.doi.org/10.1183/09031936.00166410
4. Chafin CC, Tolley EA, George C *et al.* Gender differences in metered-dose inhaler-spacer device technique. *Pharmacotherapy* 2000;**20**(11):1324-27.
5. Melani AS, Bonavia M, Cilenti V *et al.* Inhaler mishandling remains common in real life and is associated with reduced disease control. *Respir Med* 2011;**105**(6):930-30. http://dx.doi.org/10.1016/j.rmed.2011.01.005