In vitro Performance of Antistatic Compact Space Chamber Plus™ compared with the Vortex Non Electrostatic VHC and pMDI alone

Study Objective:

To quantify and compare the medication delivery characteristics of Medical Development International's new Antistatic Compact Space Chamber Plus against the Vortex Non-Electrostatic Valved Holding Chamber (VHC) using measurements of delivered dose and respirable fraction of two different classes of drugs, a reliever (salbutamol sulfate) and a preventer (beclomethasone dipropionate HFA).

Background:

The VHC acts as a reservoir for the medication from the puffer or pMDI; it does not require patient-coordinated actuation and inhalation for maximum efficiency.

The Antistatic Compact Space Chamber Plus (CSCP) can be used straight from the box (without priming), and easily fits into school bags, handbags or briefcases to allow easier storage and handling. It has a transparent body so that the respiratory valves and their movement can be easily seen and therefore enables the user to confirm correct product operation and usage.

The Vortex Non Electrostatic VHC has an opaque metal chamber and although it claims to reduce static charge, its Instruction for Use recommends that it be cleaned thoroughly before using for the first time.

Study Design:

Particle size distribution was performed using a Next Generation Impactor (NGI) at a flow rate of 30 L/min.

VHCs compared:

- Antistatic Compact Space Chamber Plus (Medical Developments International Limited).
- Vortex Non Electrostatic VHC (Pari Respiratory Equipment, Inc.)

pMDIs used:

- Salbutamol sulfate (Ventolin HFA, GSK)
- Beclomethasone dipropionate HFA (Qvar, Teva)

Three units of each VHC were tested. The pMDIs were primed according to the manufacturer's recommendations prior to initial testing. The Antistatic Compact Space Chamber Plus was tested straight out of the box without priming. The Vortex Non Electrostatic VHC was cleaned as instructed before first use according to its Instructions for Use.

Aerosol emitted from pMDIs was directed into the NGI cascade either directly (no VHC), or through a nominated test VHC. Aerosol passing through the NGI impacts on the impactor 'throat' and subsequently passes through the throat into the body of the NGI where aerosol deposits on the various stages on the basis of its aerodynamic size. There are a total of 7 impaction stages in the

NGI, as well as an MOC (micro-orifice collector) stage and a final filter. The 7 stages provide cut-off diameters from 11.7 µm at stage 1 to 0.54 µm at stage 7 for a flow rate of 30 L/min.

After collection, aerosol residue deposited at each stage is collected and quantified by HPLC against drug standards.

Results:

The results are summarised graphically for % delivered dose, respirable fractions and % throat deposition obtained with each VHC and pMDI combination, and each pMDI alone in Figures 1 – 3 respectively, and for aerodynamic particle size distribution in Figures 4-5.

Figure 1 Comparing Delivered Dose:
Antistatic CSCP vs Vortex vs pMDI alone

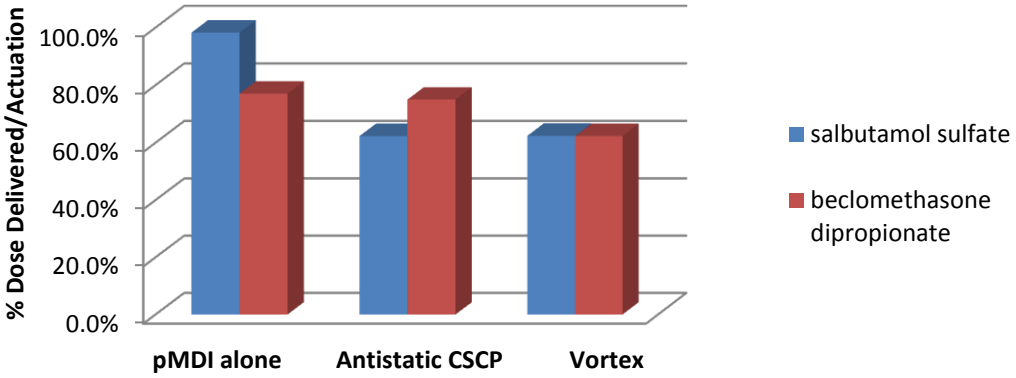


Figure 2 Comparing Mean Respirable Fraction PF% ≤ 4.7 µm:
Antistatic CSCP vs Vortex vs pMDI alone

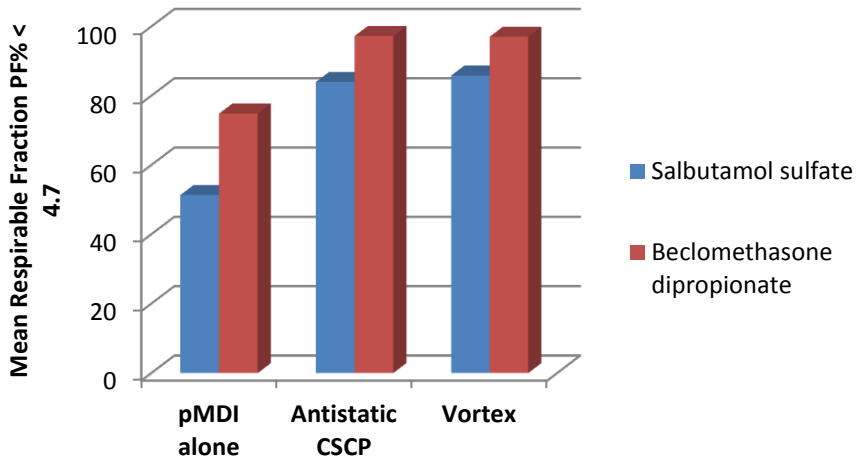


Figure 3 Comparing Throat Deposition:
Antistatic CSCP vs Vortex vs pMDI alone

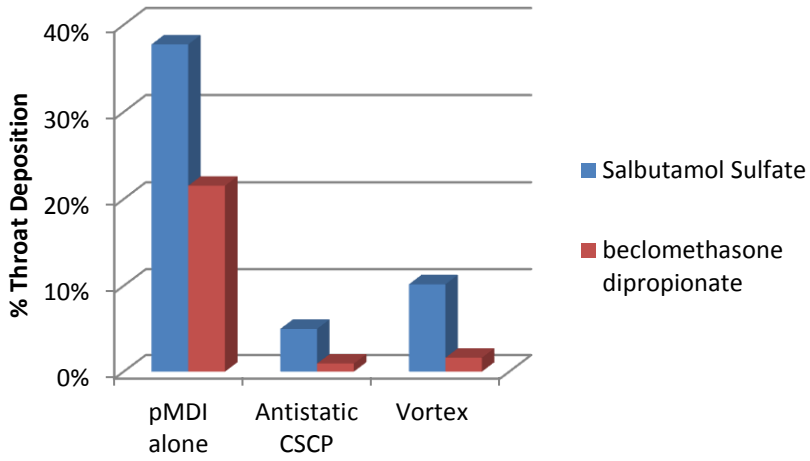


Figure 4 Comparing Aerodynamic Particle Size Distribution of Salbutamol Sulfate:
Antistatic CSCP vs Vortex Non Electrostatic VHC vs pMDI alone

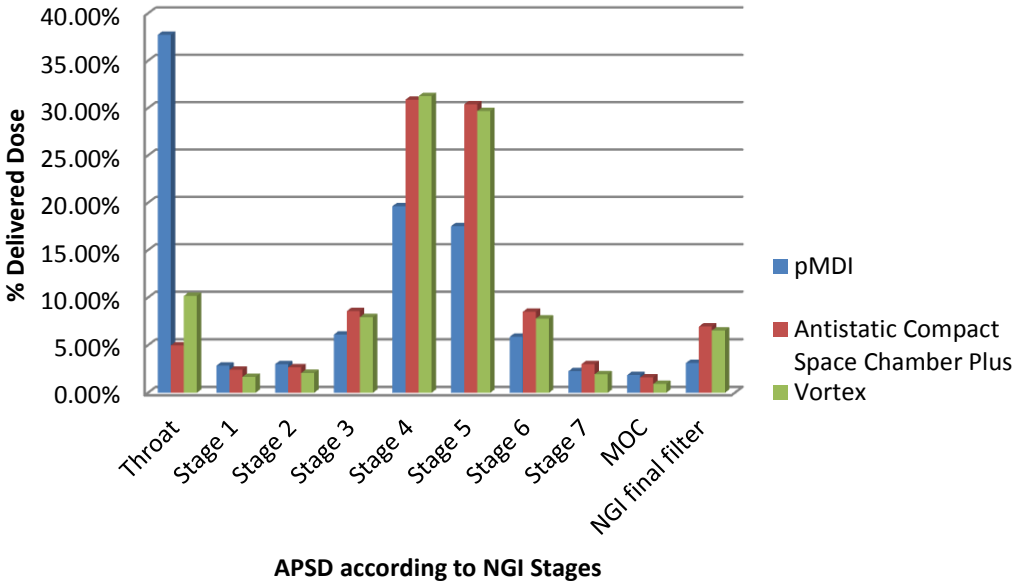
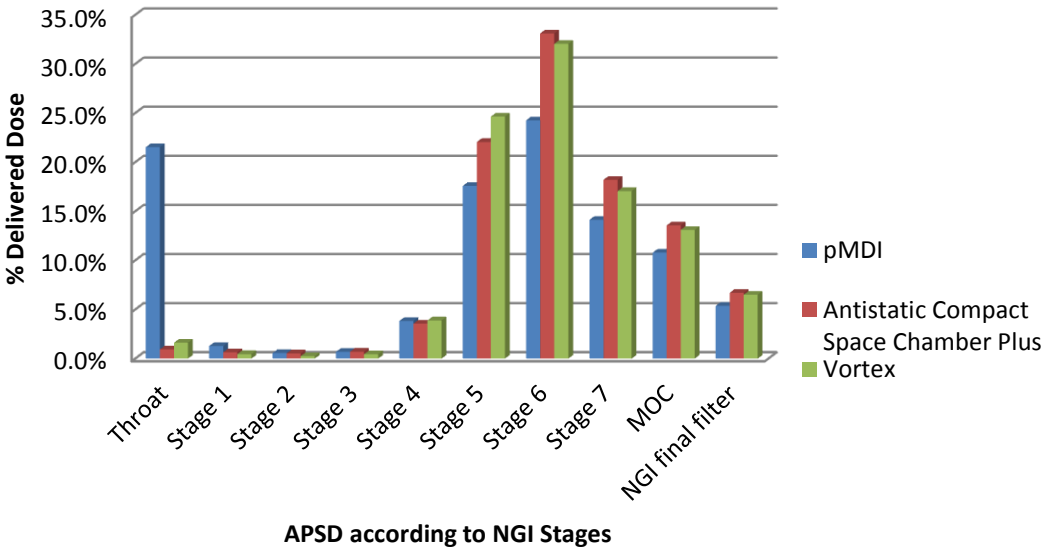


Figure 5 Comparing Aerodynamic Particle Size Distribution of Beclomethasone Dipropionate: Antistatic CSCP vs Vortex vs pMDI alone



Discussion:

In this study, the performance of Antistatic Compact Space Chamber Plus (CSCP) was compared against that of Vortex Non Electrostatic VHC and of the pMDI alone. The performance of the two VHCs was evaluated by the following parameters:

- % Delivered Dose per actuation;
- Respirable Fraction;
- % Throat deposition; and
- Aerodynamic particle size distribution (APSD).

The percentage of delivered dose per actuation is the amount of drug emitted from the drug device per actuation of the pMDI and hence available to the user. The APSD is the size of the particles or droplets that make up the emitted aerosol cloud which determines the percentage of the total delivered dose that actually reaches the lungs during inhalation (particles $\leq$ 4.7 µm), the respirable dose.

The percentage of delivered dose per actuation by each VHC and pMDI alone is compared in **Figure 1**. Comparable results for % delivered dose per actuation were obtained for both VHCs for the respective drugs although the salbutamol pMDI delivers the highest quantity of medication. **Figure 2** compares the respirable fractions for the two VHCs and the pMDIs alone. For each medication tested, the respirable fractions delivered by the VHCs are comparable and greater than those delivered by the pMDIs alone. **Figure 3** compares the percentage of dose deposited on the throat. This figure shows that although the pMDI alone delivers more salbutamol medication than either VHCs (**Figure 1**), a large proportion of the delivered dose from the pMDI alone is deposited on the 'throat'. Both VHCs are able to significantly reduce the proportion of each drug deposited on the throat in a comparable manner. **Figures 4** and **5** compare the APSD of each medication using the

pMDI alone, and using the two VHCs in conjunction with the pMDIs. The figures show that when VHCs are used in conjunction with the pMDI, they significantly increase the respirable particle fraction of the medications (ie medications delivered approximately to stage 4 onwards), and therefore the proportion of the medications that are able to penetrate and deposit on receptors in the proximal and distal airways.

Conclusion:

The results of the study demonstrate that Medical Development International's Antistatic Compact Space Chamber Plus is equivalent in performance to Pari's Vortex Non Electrostatic VHC.

The results also show that use of VHCs with pMDIs increases the amount of medication particles in the respirable range that would reach the lungs and be therapeutically effective. The VHCs reduce the amount of medication deposited in the upper respiratory tract and therefore decrease the chance of local side effects.