

Determining the Influence of Washing on the Aerosol Performance of an Anti-Static Valved Holding Chamber

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Introduction



Figure 1. The OptiChamber Diamond VHC can be used to optimize delivery from pMDIs.

The valved holding chamber (VHC) has been designed to help improve and optimize delivery for those using pressurized metered dose inhalers (pMDIs).^[1] The OptiChamber Diamond VHC (Figure 1; Diamond; Philips Respironics, Respironics New Jersey, Inc., Parsippany, NJ) is a compact, anti-static VHC designed to facilitate effective aerosol delivery to respiratory patients. This study compared the aerosol characteristics of an unwashed ('out-of-the-box') and prewashed preproduction Diamond VHC using three pMDI drug formulations.

Results

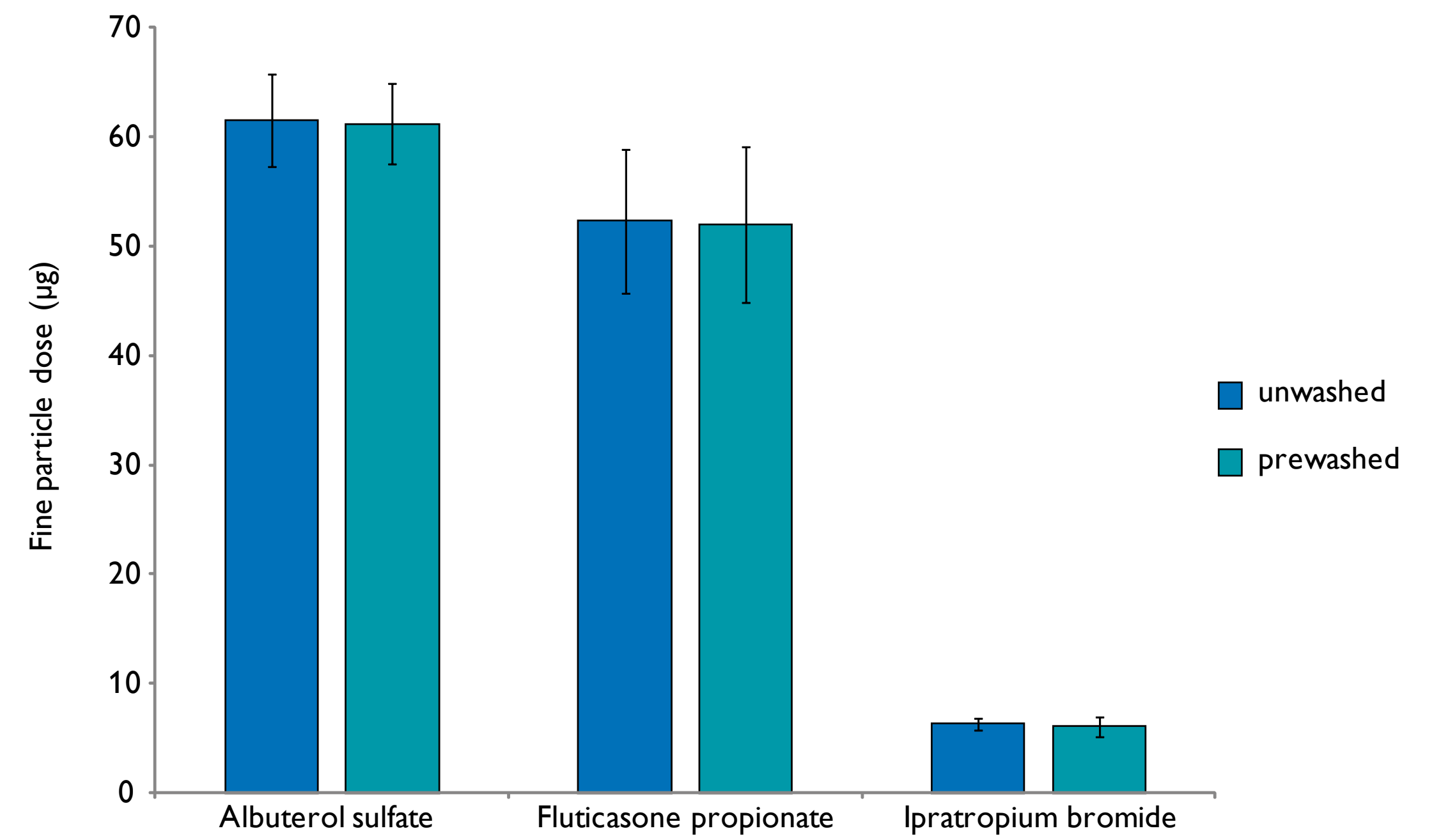


Figure 4. Mean fine particle dose (amount of drug in NGI $\leq 4.7 \mu\text{m}$) from the unwashed Diamond VHCs and prewashed Diamond VHCs. Error bars denote standard deviation about the mean.

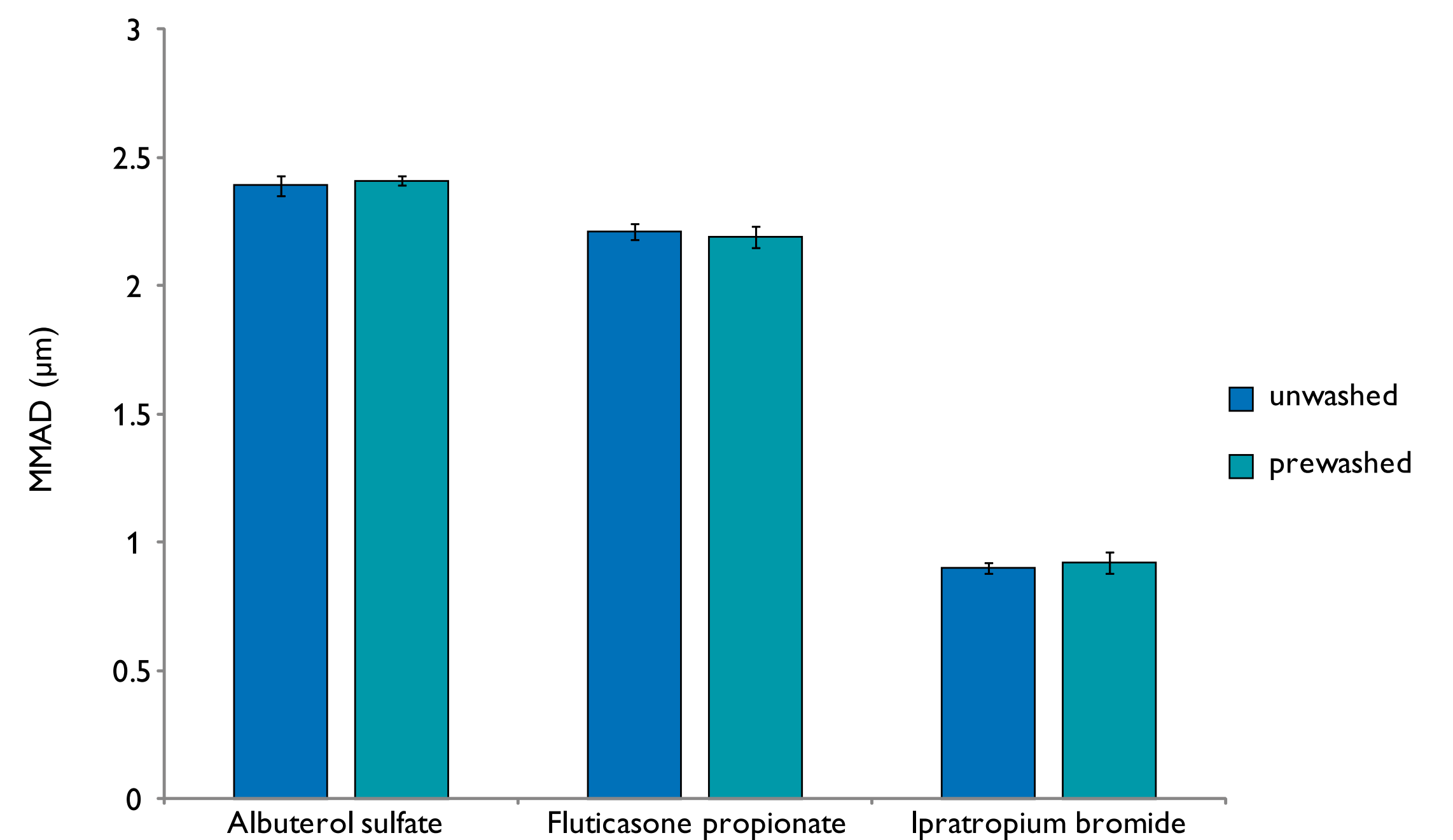
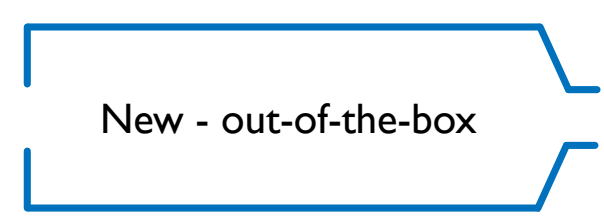


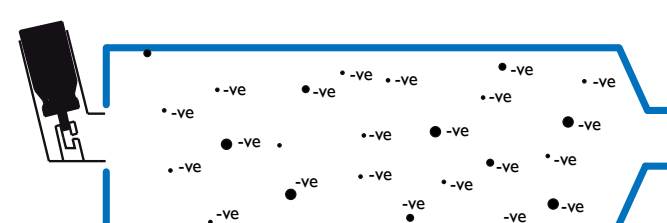
Figure 5. Mean MMAD (mass median aerodynamic diameter) from the unwashed Diamond VHCs and prewashed Diamond VHCs. Error bars denote standard deviation about the mean.

Anti-static VHC

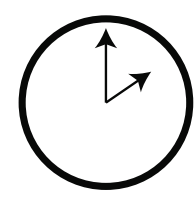
Anti-static VHCs are made of materials that dissipate electrostatic charge.



No need to wash before first use.

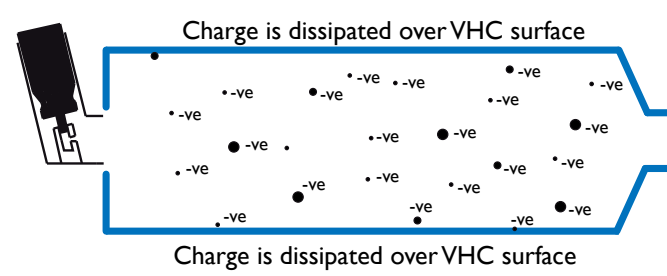


Upon actuation electrostatic charges are produced on the aerosol particles.^[1]



Over time the VHC will be subject to new sources of charge.

If there is a build up of static charge on the VHC walls, upon actuation the aerosol particles with opposite charges will be attracted to the VHC walls, leading to a rapid reduction in the dose available for inhalation.

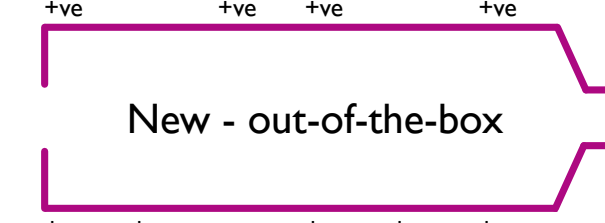


VHC keeps aerosol in chamber longer giving time for patient to inhale complete dose of drug.

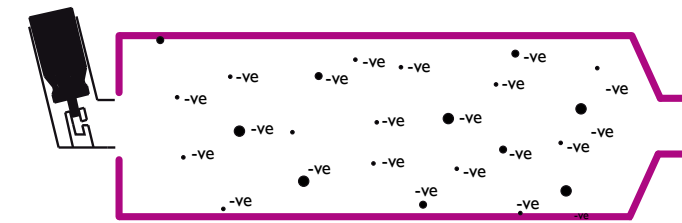
Increased convenience for user - washing requirement for hygiene.

Conventional VHC

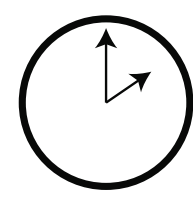
Conventional VHCs suffer from a build up of charge on the surface of the non-conducting material over time.^[2]



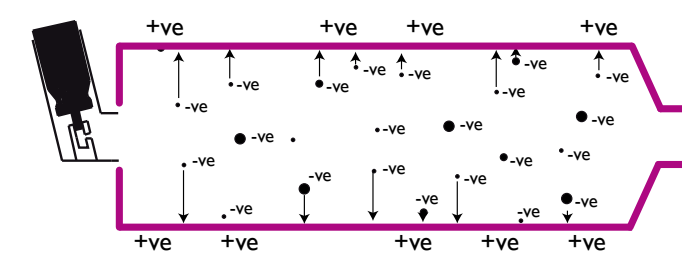
Need to wash before first use.^[1]



Without regular and frequent washing the dose available for inhalation reduces rapidly over time.



User should wash with ionic detergent frequently - washing reduces static charge.



Discussion

Both the fine particle doses and MMADs for the three pMDI drug formulations were similar from unwashed and prewashed Diamond VHCs. The practical benefit of these results is that they show that users and care givers can use a new Diamond VHC for treatment as soon as it is removed from the packing without having to wash the device first, as is the case with conventional VHCs.

Conclusions

- There were minimal differences in the aerosol characteristics between the unwashed and prewashed pMDI VHC combinations with all of the drugs tested.
- The results indicate that the aerosol performance of the Diamond VHC is the same when used in either unwashed or prewashed states.

References

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Figure 2. Rationale behind the use of an anti-static VHC

Method

	pMDI	VHCs	Laboratory equipment
Materials	<ul style="list-style-type: none"> 6 x ProAir HFA, 90 µg albuterol, Teva Specialty Pharmaceuticals. 6 x Flovent HFA, 110 µg fluticasone propionate, GlaxoSmithKline. 6 x Atrovent CFC-free, 20 µg ipratropium bromide, Boehringer Ingelheim. 	6 x preproduction Diamond VHCs	<ul style="list-style-type: none"> Next Generation Impactor High Performance Liquid Chromatography
Pre-test conditioning	<ul style="list-style-type: none"> ProAir 3 x priming actuations Flovent 4 x priming actuations Atrovent 2 x priming actuations pMDI canister removed from actuator for shaking before all subsequent actuations 	<ul style="list-style-type: none"> Used in an out-of-the-box condition (unwashed tests) or Washed in warm soapy water, rinsed and air dried 	All equipment and fluids stabilized to ambient conditions NGI leak tested
Tests	<ul style="list-style-type: none"> Tests conducted on: <ul style="list-style-type: none"> unwashed Diamond VHC (n=6) washed Diamond VHC (n=6) Where each test comprised: <ul style="list-style-type: none"> 1 x pMDI priming shot (except Atrovent - as per manufacturers instructions) (pMDI actuated, 20 s extraction flow) x 10 Extraction stopped after a further 10 s 		

Figure 3. Experimental test method.

After each test, the induction port, back-up filter, NGI cups and VHCs were processed using the relevant HPLC assay diluent. CITDAS V3.10 software was used to generate the aerosol characteristics data. The fine particle dose (amount of drug in NGI $\leq 4.7 \mu\text{m}$), and Mass Median Aerodynamic Diameter (MMAD) were calculated.

