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## ***An in vitro comparison of the impact of jet nebulizer design on the aerosol characterization of commonly used asthma drugs***

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### **◆ Find This Study**

*Data on File*

### **◆ The Study**

Depending upon design, jet nebulizers are typically classified as conventional (e.g. Salter 8900), active venturi (e.g. Sidestream®) or breath-enhanced (Pari LC Plus®). Design differences are likely to affect the characteristics of aerosol delivery. This study presents the results of an in vitro comparison of nebulizer classifications using three commonly used asthma medications.

Three units of each of the nebulizer brands were randomly selected. An Inspiration Elite compressor was used throughout. Study drugs: albuterol (2.5 mg, 3 mL), ipratropium bromide (0.5 mg, 2.5 mL) and budesonide (0.5 mg, 2 mL). For determination of particle size (mass median aerodynamic diameter (MMAD)), respirable fraction (RD), and delivery rate (DR), the drug-filled nebulizers were connected to an In-Tox cascade impactor. Tests were run in triplicate and a spectrophotometer technique was used for drug characterization. The tests were conducted as per FDA guidance (Piper Medical Products, Carmichael, CA).

### **◆ The Results**

The results highlight the impact of nebulizer design on important aerosol drug characteristics when using standardized testing methodology.

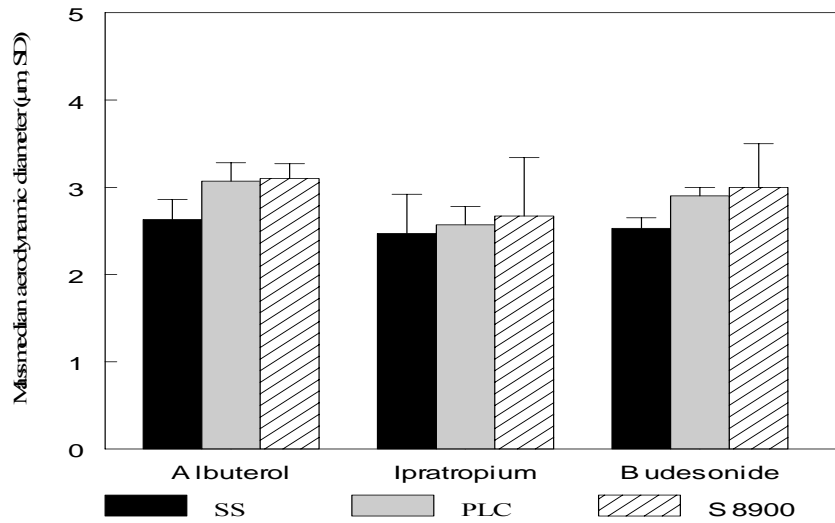
### **◆ What's New**

The study data documents high quality, efficient aerosolization by Respironics' Sidestream as compared to the Pari LC+. For our customers, Sidestream delivers this high quality performance while simultaneously providing a value-priced alternative to the premium pricing of the LC+. Using FDA guidance test methodology, Sidestream's performance is well-aligned to the LC+, while comfortably exceeding that of the low-end Salter 8900 handset.

### **◆ Bottom Line**

Sidestream's unique, active-venturi, five jet-hole design, generates a high quality (a high percentage of respirable particles in the nebulizer output) aerosol that is superior to conventional and competitive with breath-enhanced designs.

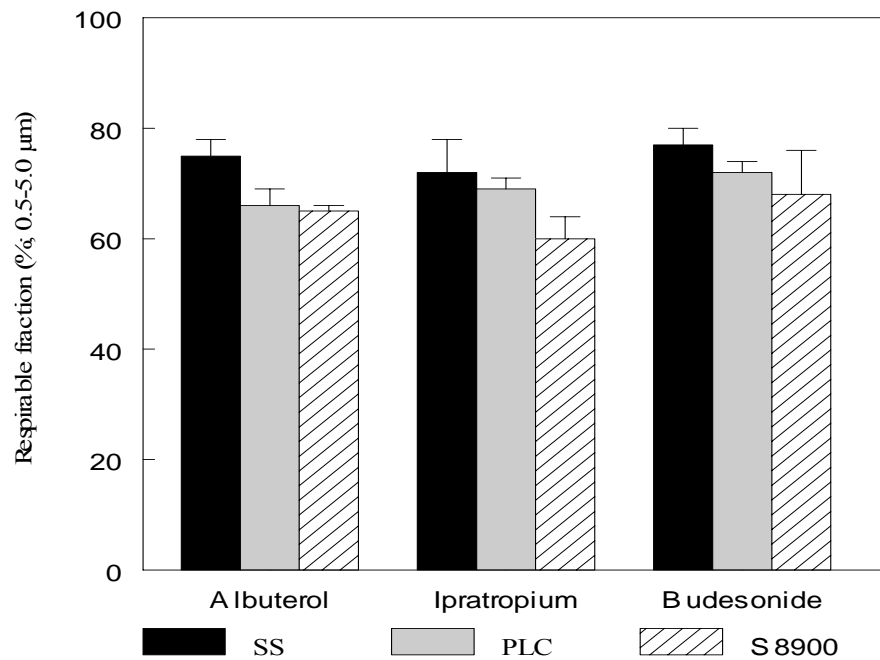
**Figure 1**  
**Mass median aerodynamic diameter (MMAD)**



<b>MMAD (µm)</b>			
	<b>albuterol</b>	<b>ipratropium</b>	<b>budesonide</b>
<b>Sidestream</b>	<b>2.6</b>	<b>2.5</b>	<b>2.5</b>
<b>LC+</b>	<b>3.1</b>	<b>2.6</b>	<b>2.9</b>
<b>Salter 8900</b>	<b>3.1</b>	<b>2.7</b>	<b>3.0</b>

**Statistics:** There are no statistically significant differences in the MMAD between the nebulizers for any of the three drugs.

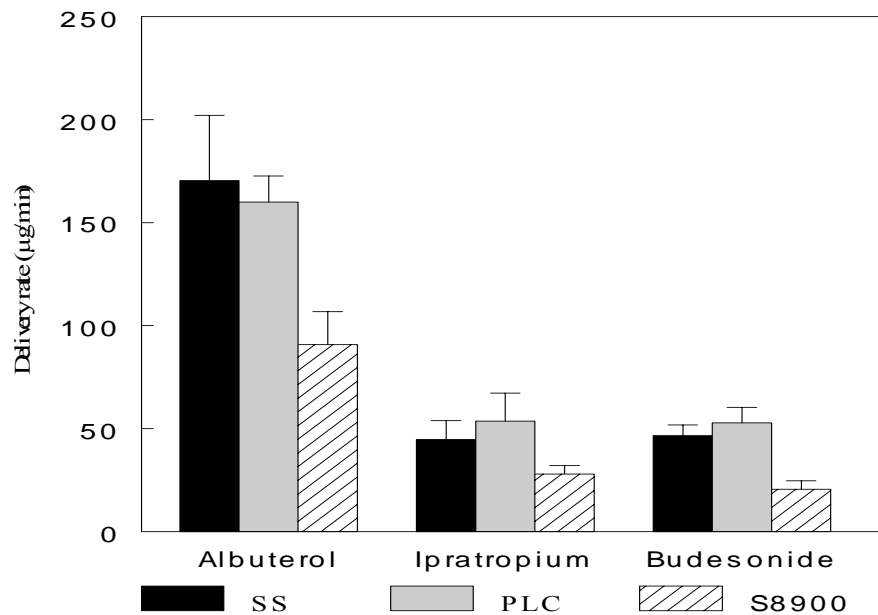
**Figure 2**  
**Respirable Fraction**



<b>Respirable Fraction (%)</b>			
	<b>albuterol</b>	<b>ipratropium</b>	<b>budesonide</b>
<b>Sidestream</b>	<b>74.7</b>	<b>72.0</b>	<b>77.0</b>
<b>LC+</b>	<b>65.7</b>	<b>68.7</b>	<b>72.0</b>
<b>Salter 8900</b>	<b>65.0</b>	<b>60.3</b>	<b>68.0</b>

**Statistics:** There are statistically significant nebulizer dependent differences in respirable fraction in percent of total drug delivery for albuterol and ipratropium (ANOVA, albuterol p=0.0076; ipratropium p=0.0405), but not for budesonide.

**Figure 3**  
**Delivery Rate**



<b>Delivery Rate (µg/min)</b>			
	<b>albuterol</b>	<b>ipratropium</b>	<b>budesonide</b>
<b>Sidestream</b>	<b>170.4</b>	<b>44.7</b>	<b>46.6</b>
<b>LC+</b>	<b>159.9</b>	<b>53.7</b>	<b>52.8</b>
<b>Salter 8900</b>	<b>90.8</b>	<b>27.9</b>	<b>20.5</b>

**Statistics:** There are statistically significant nebulizer dependent differences in delivery rates for all three drugs (ANOVA, albuterol p=0.0083; ipratropium p=0.0457; budesonide p=0.0011).

