The Choice of Replacement Nebulizer Can Improve Delivery Efficiency of the Original Aerosol System

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Introduction:
It is recommended that patients clean and replace their nebulizer on a regular basis to maintain optimal device performance and efficient drug delivery. This practice is especially important for those patients with older nebulizer systems. However, performance characteristics of the replacement nebulizer may differ from that of the original system, potentially affecting the therapeutic efficacy of the delivered drug. Therefore, it is important to understand how replacement nebulizers may impact delivery performance when paired with the original compressor.

Purpose:
The aim of this study is to determine the in-vitro delivery efficiency of the LC Sprint Reusable Nebulizer (PARI Respiratory Equipment, Inc. USA), when used as a replacement for the original nebulizer, DeVilbiss 800 Nebulizer with the Pulmoaide Compressor (DeVilbiss Healthcare, Sommerset, PA USA) (Figure 1).

Methods:
The LC Sprint Nebulizer/Pulmoaide and 800 Nebulizer/Pulmoaide were compared and tested in triplicate with albuterol (2.5 mg in 3 ml, Nepron, Orlando, FL). Aerosolising and distribution by cascade impaction, 200 μl of radioisotope 99mTc-pertechnetate was added to the solution. Prior testing confirmed homogeneity for co-location of 99mTc-pertechnetate and albuterol. Output tested under simulated breathing conditions (VT 500 ml/15 bpm/ duty cycle 0.5), timed until dry. Respirable dose (RD) is the total drug delivered in the respirable range (<5μ) and calculated: DDR (mg/min) x nebulization time x RF (%). Respirable Drug Delivery Rate (RDDR) is the amount of drug delivered in the respirable range/minute and calculated: Charge dose (mg/L) x delivery rate (mL/min) x RF(%). *A statistically significant increase in RD and RDDR by 126% and 300% respectively with 32% faster nebulization when replacing the DeVilbiss 800 Nebulizer with LC Sprint Reusable Nebulizer and Pulmoaide Compressor (Figure 1). The difference in MMAD was not statistically significant (Table 1). A statistically significant increase was noted in RD and RDDR by 126% and 300% respectively with 32% faster nebulization when replacing the DeVilbiss 800 Nebulizer with LC Sprint Reusable Nebulizer and Pulmoaide Compressor (Figure 1).

Results:
The difference in MMAD was not statistically significant (Table 1). A statistically significant increase was noted in RD and RDDR by 126% and 300% respectively with 32% faster nebulization when replacing the DeVilbiss 800 Nebulizer with LC Sprint Reusable Nebulizer and Pulmoaide Compressor (Figure 1).

Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Pulmoaide/800 (original)</th>
<th>LC Sprint/800 (replacement)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMAD [µm]</td>
<td>3.1</td>
<td>3.4</td>
<td>0.37</td>
</tr>
<tr>
<td>RD [µg]</td>
<td>0.30</td>
<td>0.48</td>
<td>0.02</td>
</tr>
<tr>
<td>RDDR [µg/min]</td>
<td>0.83</td>
<td>0.12</td>
<td>0.02</td>
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<tr>
<td>Nebulization time [min, dryness]</td>
<td>9.1</td>
<td>6.2</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Conclusions
These data demonstrate that delivery performance may change when the replacement nebulizer differs from that of the original system. For this particular study, the delivery efficiency of albuterol improved when the DeVilbiss 800 nebulizer was replaced with the LC Sprint Reusable Nebulizer. Additional drug formulations and nebulizer/compressor combinations warrant testing for a more comprehensive evaluation.

Clinical Implications
The potential for variability in drug delivery is significant when the replacement nebulizer differs from the nebulizer packaged with the original aerosol system. However, this variability may have positive or negative effects on therapeutic response depending on the drug administered and the efficiency of the replacement nebulizer. Doses may need to be adjusted accordingly. Further investigation will help determine the clinical relevance of these findings.