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Assessment of Two Oscillating Positive Expiratory Pressure (OPEP) Devices: How do the Differing Mechanisms of Action Impact Lab Performance



INTRODUCTION

OPEP devices are often used therapeutically in order to aid airway clearance where excess mucus is a challenge, such as in cystic fibrosis, bronchiectasis and chronic obstructive pulmonary disease.

Real world differentiators for different types of OPEP devices include:

- Ease of use;
- Ability to clean, and;
- Adaptability to use with nebulizers.

The mechanism of action between devices can also differ, which is likely to result in different patient outcomes.

This laboratory study compared an established, clinically supported OPEP device with a recently introduced one that is based on older technology. Key in-vitro performance parameters were compared.



METHODS

Devices tested:

- **Aerobika**^{*} (Trudell Medical International, Canada) and **AirPhysio**[†] (AirPhysio, Australia) OPEP devices (n=3)

Test set up:

- Assessment performed at steady expiratory flows of 10-30L/min using a flow generator (Resmed VPAP III), flow meter (TSI 4000), pressure tap and computer for data collection and analysis.

Outcomes:

- Average positive pressure, pulse amplitude and pulse frequency were determined for each device.



Aerobika*
(Trudell Medical International, Canada)



AirPhysio[†]
(AirPhysio, Australia)

METHODS

- The **Aerobika**^{*} device and **AirPhysio**[†] device function via two different mechanisms of action.
- The **Aerobika**^{*} device operates via a **pivoting vane and valve** mechanism (Fig 1), while the **AirPhysio**[†] device functions through a **metal ball and cone** mechanism (Fig 2).
- The differing mechanisms of actions may impact performance parameters as well as usability

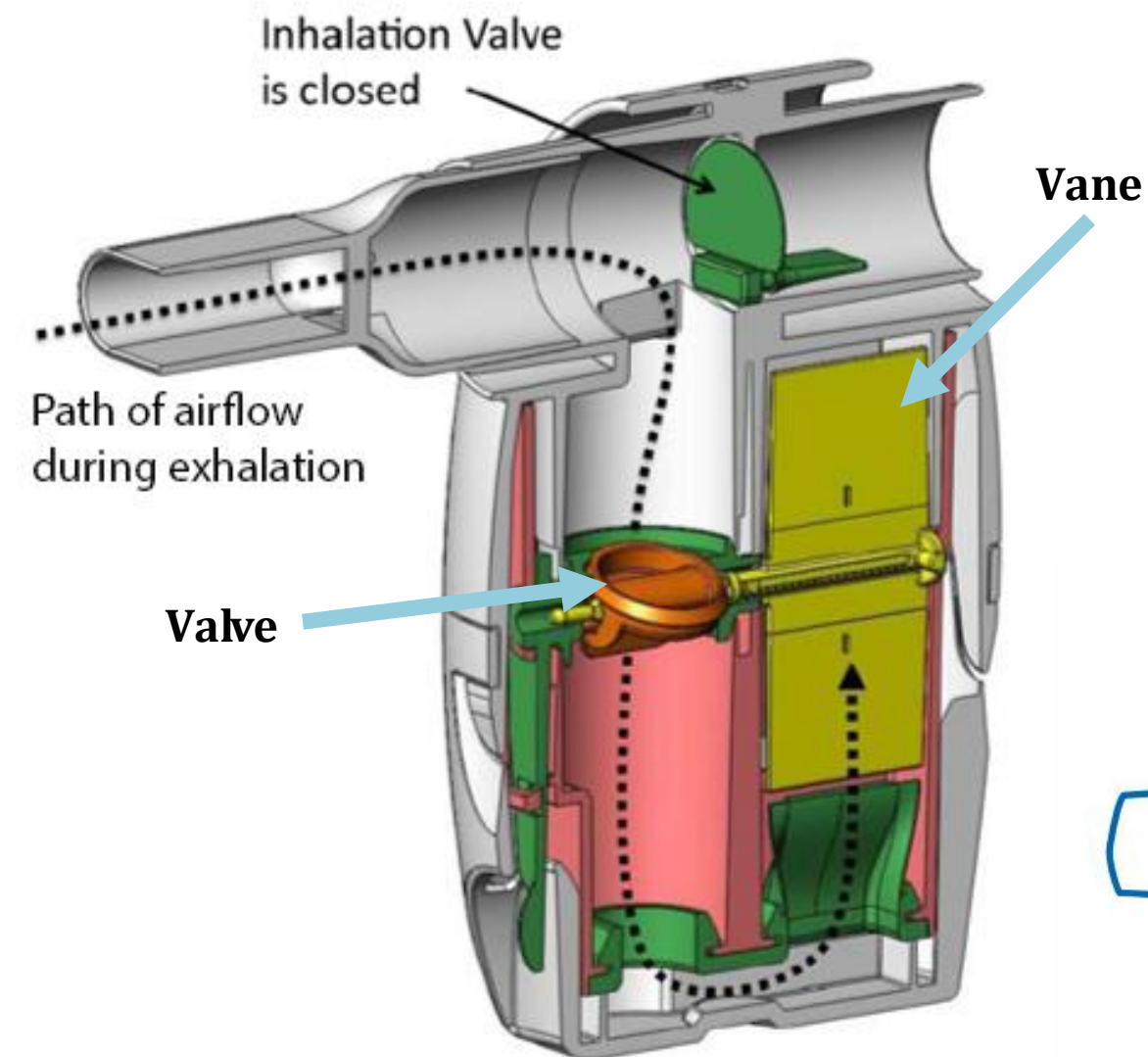


Fig 1. Pivoting vane and valve mechanism

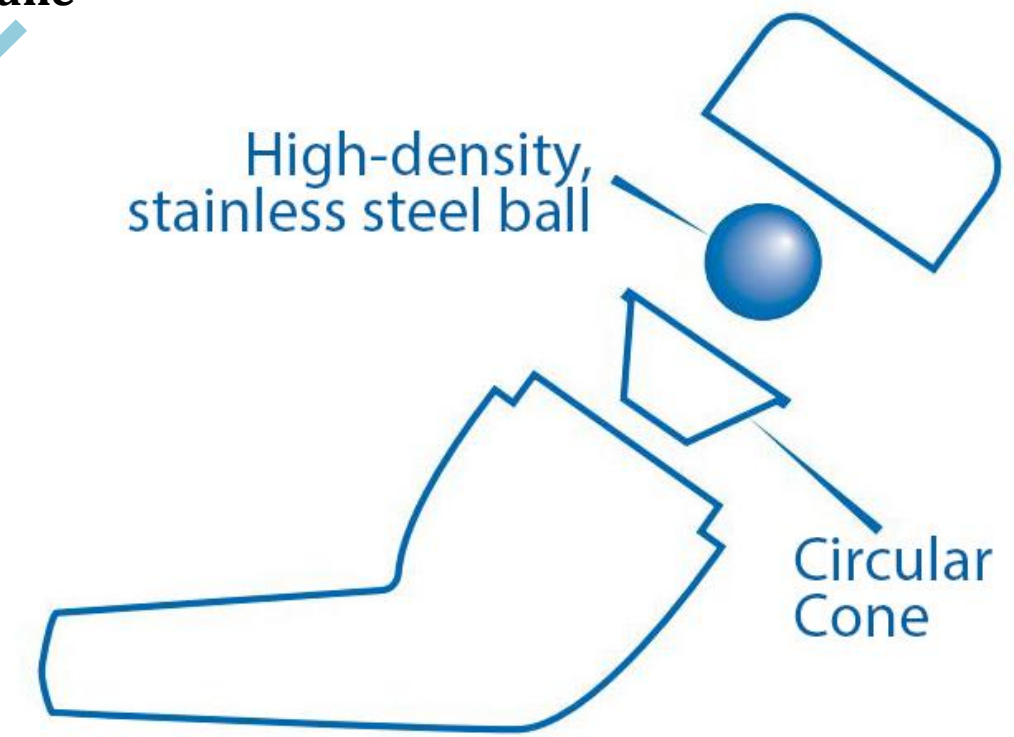


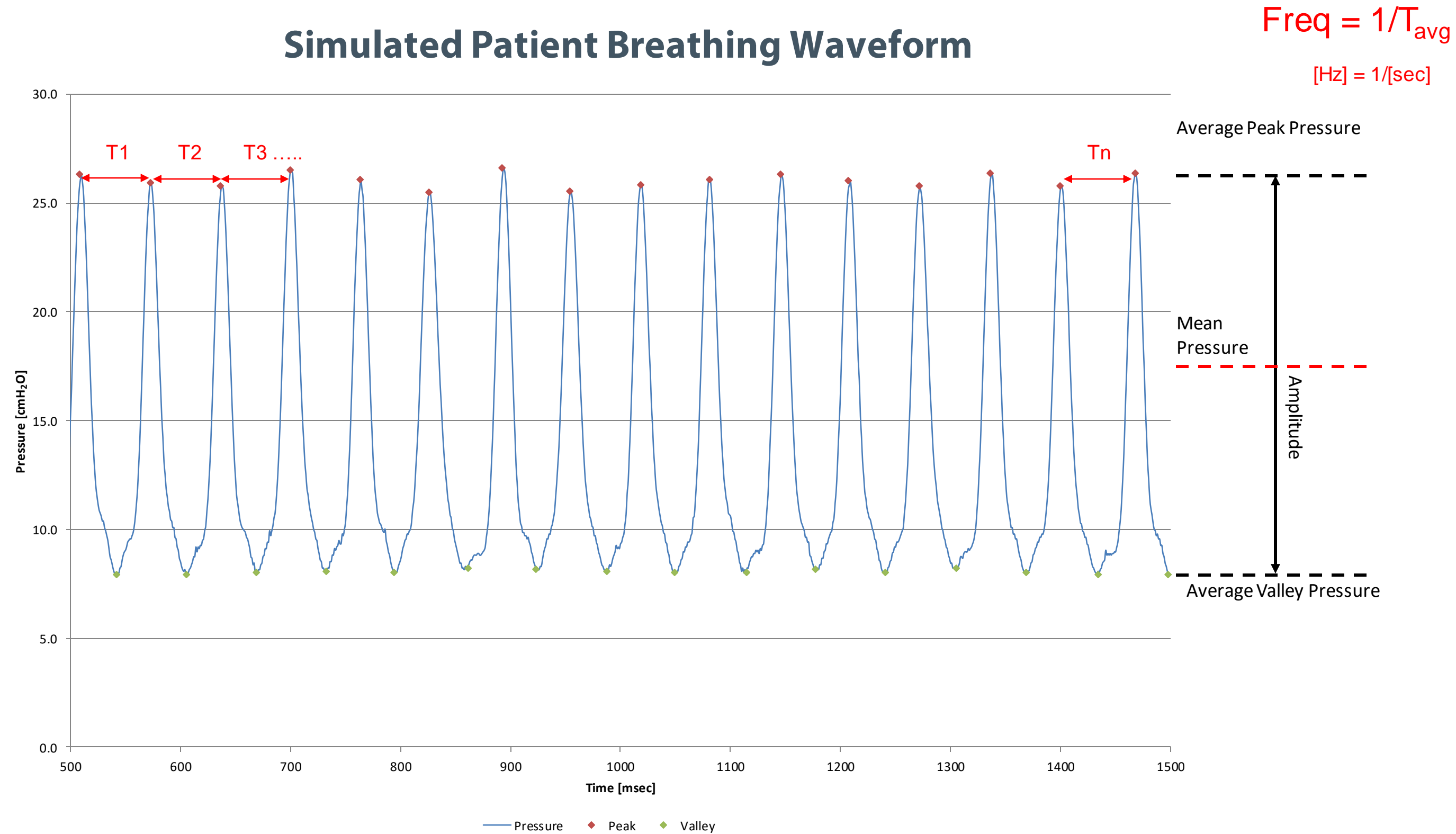
Fig 2. Metal ball and cone mechanism*

* The diagram pictured here is not specific to the AirPhysio[†] device, but rather illustrates the metal ball and cone mechanism that the device uses.



LAB PERFORMANCE METRICS

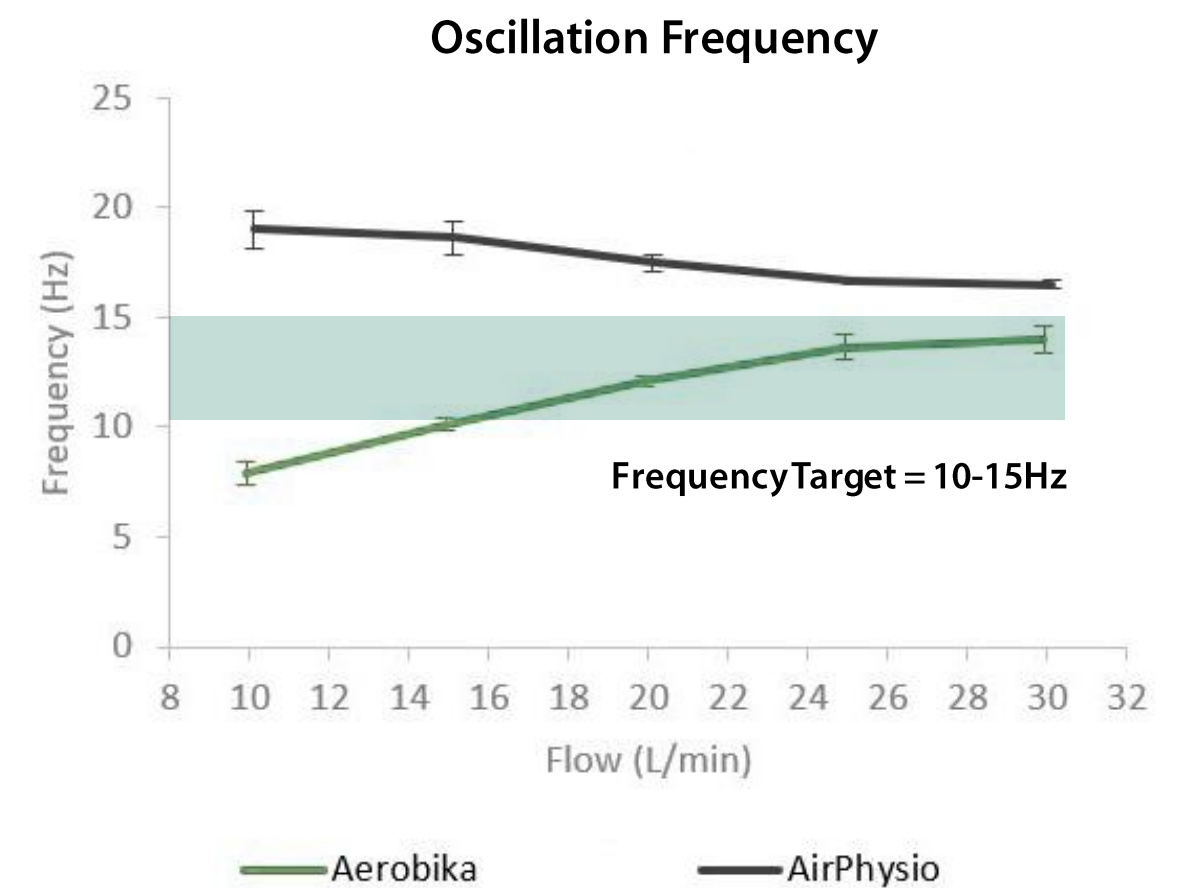
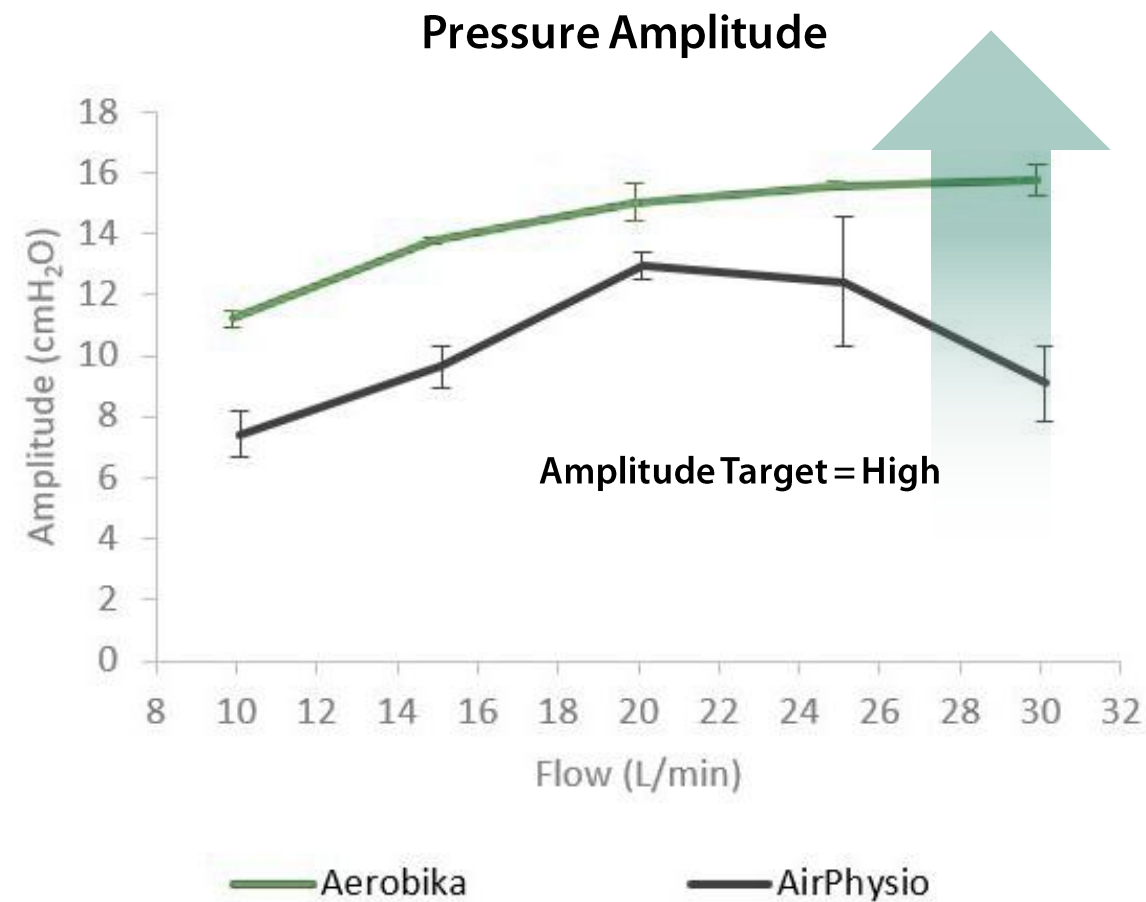
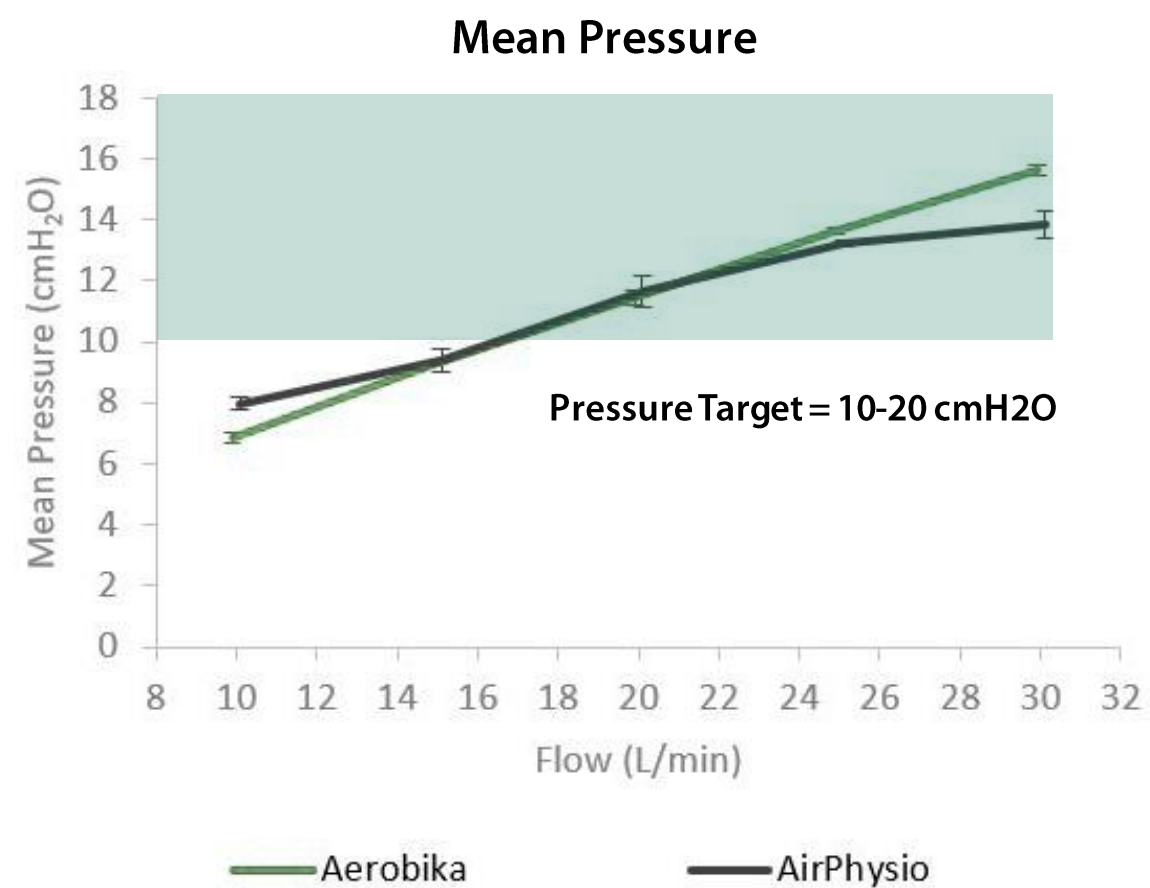
Simulated Patient Breathing Waveform





RESULTS

As each device can be operated at different resistances, the values at medium resistance are reported in the figures below.





DISCUSSION

- For effective performance, oscillation frequency is typically desired to be in the 10-15 Hz range. This frequency range is optimal as it aligns with the cilia beat frequency (approximately 13 Hz) to support more efficient natural mucociliary clearance¹.
 - The **Aerobika*** OPEP device exhibited frequencies more often in the desired range.
- Moreover, therapeutic effectiveness is in part dependent on mean pressure ideally between 10-20 cm H₂O, with pulse (pressure) amplitude as large as possible. Higher amplitudes indicate greater changes in pressure differentials which can create stronger shear forces that reduce the viscoelastic properties of bronchial secretions² enabling secretions to be cleared from the airways.³
 - Both devices exhibited similar average positive pressures, close to or within the desired range
 - The **Aerobika*** OPEP device exhibited higher pressure amplitudes

¹ Silva C, *et al.* Respiratory Care 2009;54(11):1480-1487. ² Coppola D, Schloss J, Suggett J, Mitchell, J. Non-Pharmaceutical techniques for obstructive airway clearance focusing on the role of oscillating positive expiratory pressure (OPEP): a narrative review. Pulm Ther. 2021. ³ Van Fleet H, *et al.* Respiratory Care. 2017;62(4):451-458.

CONCLUSIONS

- The results for the two devices show that although mean pressures are similar across the range of flow rates, the amplitudes are higher for the **Aerobika*** OPEP device, and the frequencies are often in the desired range, while they are not for the **AirPhysio**† device. The observed differences are probably due to the fact that each device operates according to a different mechanical principle.
- These results show that it is important to understand that each OPEP device can perform differently mechanically. All devices will not perform the same.
- When selecting an OPEP device for a patient, real world usability assessments, as well as the existence of clinical evidence supporting efficacy should be considered.

