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Revolutionize Respiratory Disease Treatment Using a Smart Dry Powder Inhaler

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Revolutionize Respiratory Disease Treatment Using a Smart Dry Powder Inhaler.

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INTRODUCTION

Problem: Treatment Outcomes

- 25 million people suffer from asthma and 15 million from COPD in the US.
- Current devices used for treatment are traditional pressurized Meter Dose inhalers (pMDI), Dry Powder inhalers (DPI), and Nebulizers.
- However, existing inhalers lead to suboptimal drug delivery to the lungs, due to poor inhaler use technique.
- **Multiple-step process to use the DPI (Fig1): 55% of people make at least one serious mistake when using their DPI, which leads to non-adherence, exacerbations, hospitalization, and increased mortality.**

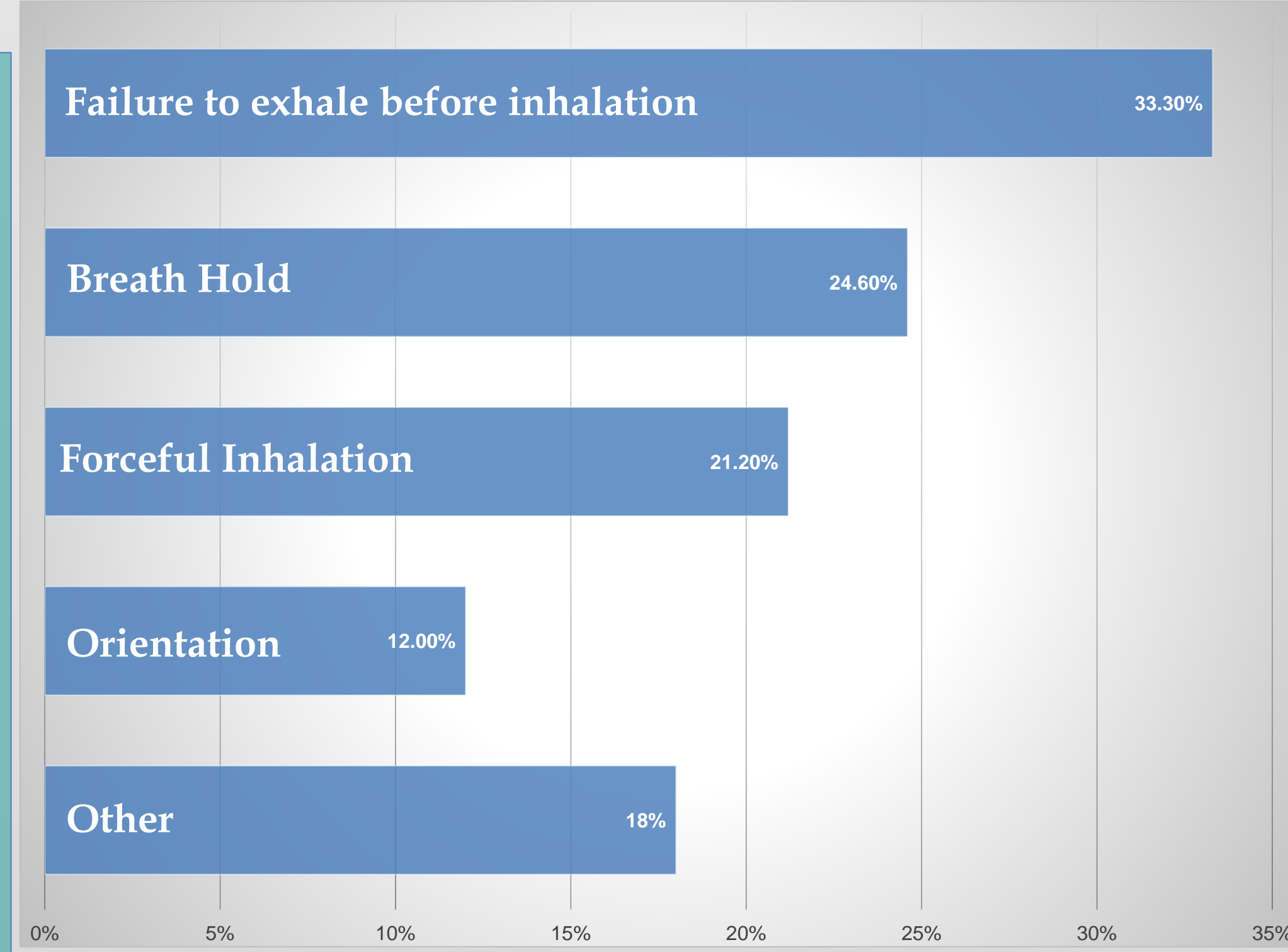


Fig 1: Errors made by patients while using DPI



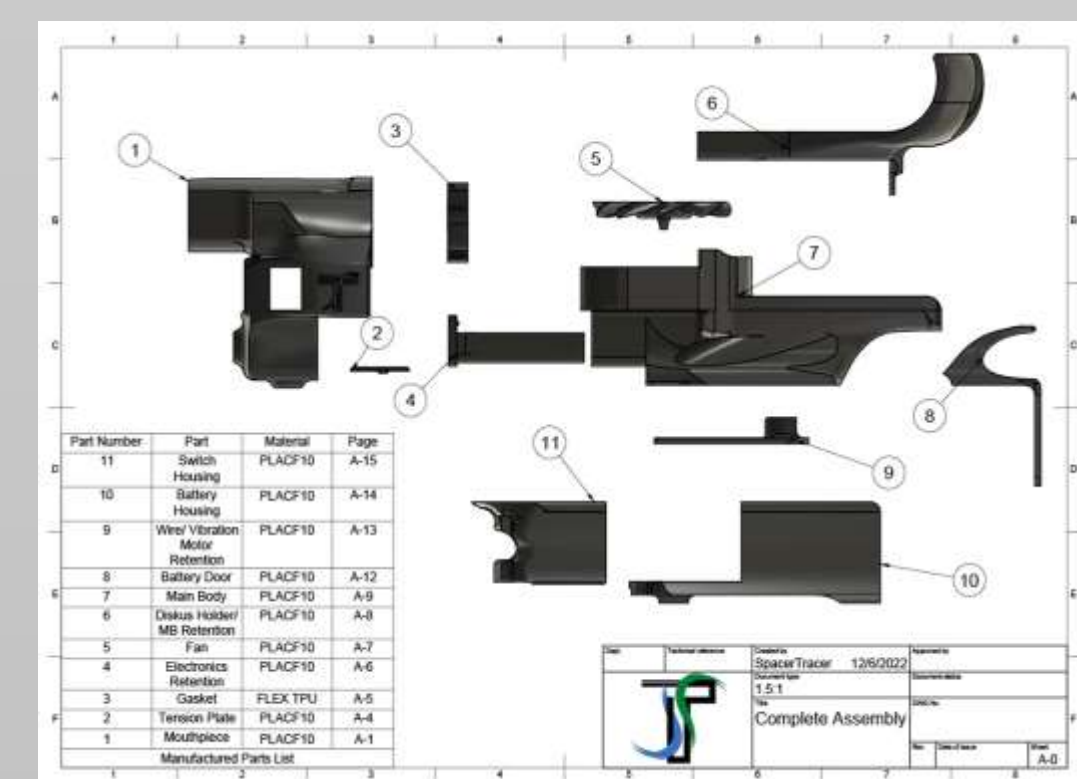
Conventional inhalers



Smart inhalers

Scientific Breakthrough: Smart Adaptor

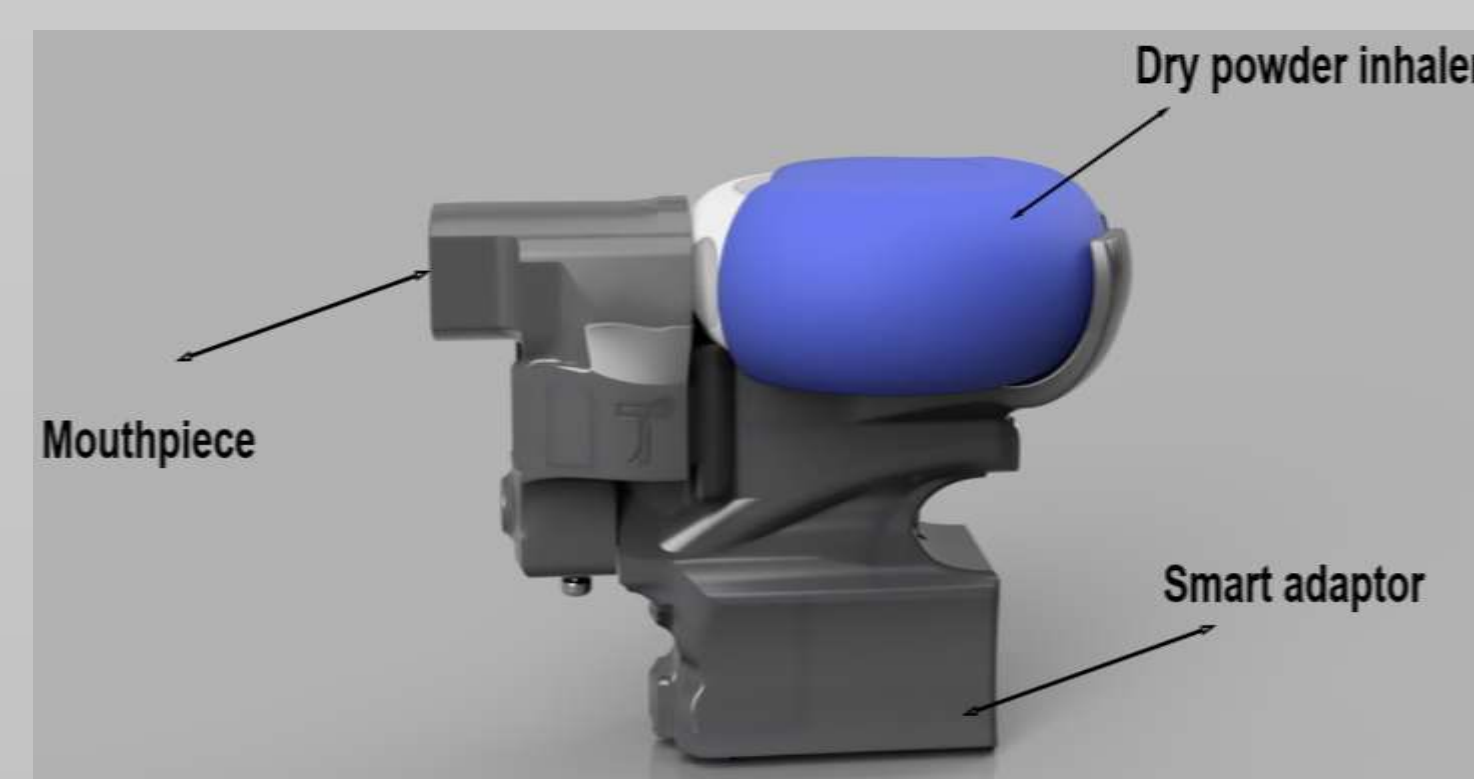
- Guesswork is replaced by precision. The smart adaptor will guide the patient, thus improving their inhaler use experience
- Our smart adaptor is capable of:
 1. Giving patients real-time feedback to improve inhaler use technique.
 2. Measuring Peak Inspiratory and Expiratory flow rate (PIF and PEF).
 3. Our adaptor is designed to assist patients in receiving the correct dosage, ensuring their treatment is properly guided.
 4. Our adaptor can generate visual and haptic cues (light and vibration) based on the airflow generated in the adaptor.
- Therefore, our smart adaptor can overcome the limitations of traditional inhalers.



Add-on sensors



DPI



Smart DPI

METHODS

Air Flow rate measurement

- The smart adaptor can be added to all existing types of DPI.
- We developed our smart adaptor using a simple but powerful **Anemometer fan (Fig 2)** connected to a light sensor.
- The Anemometer fan can measure the number of revolutions per second and correlates with airflow.

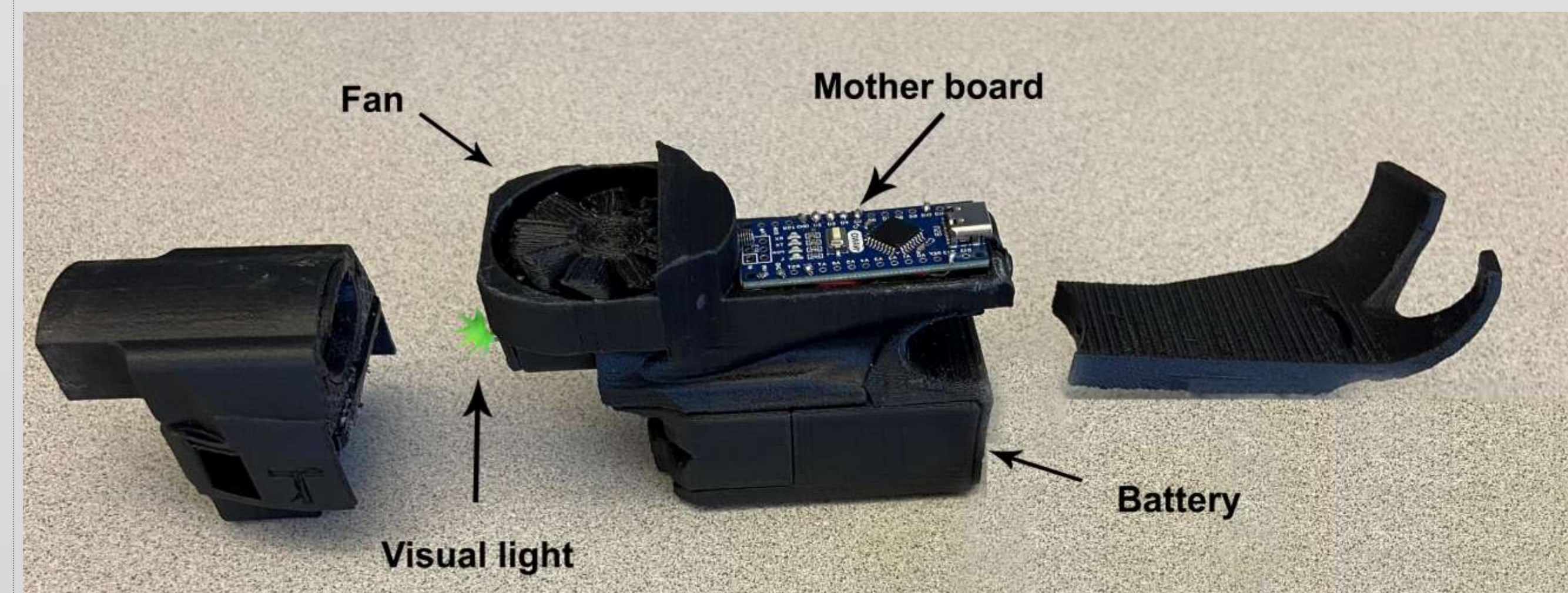


Fig 2: The breakdown of a 3D printed smart adaptor.

Inhalation → Airflow → Fan Revolution → Light/Vibration cues
 Exhalation → Airflow → Fan Revolution → Light/Vibration cues

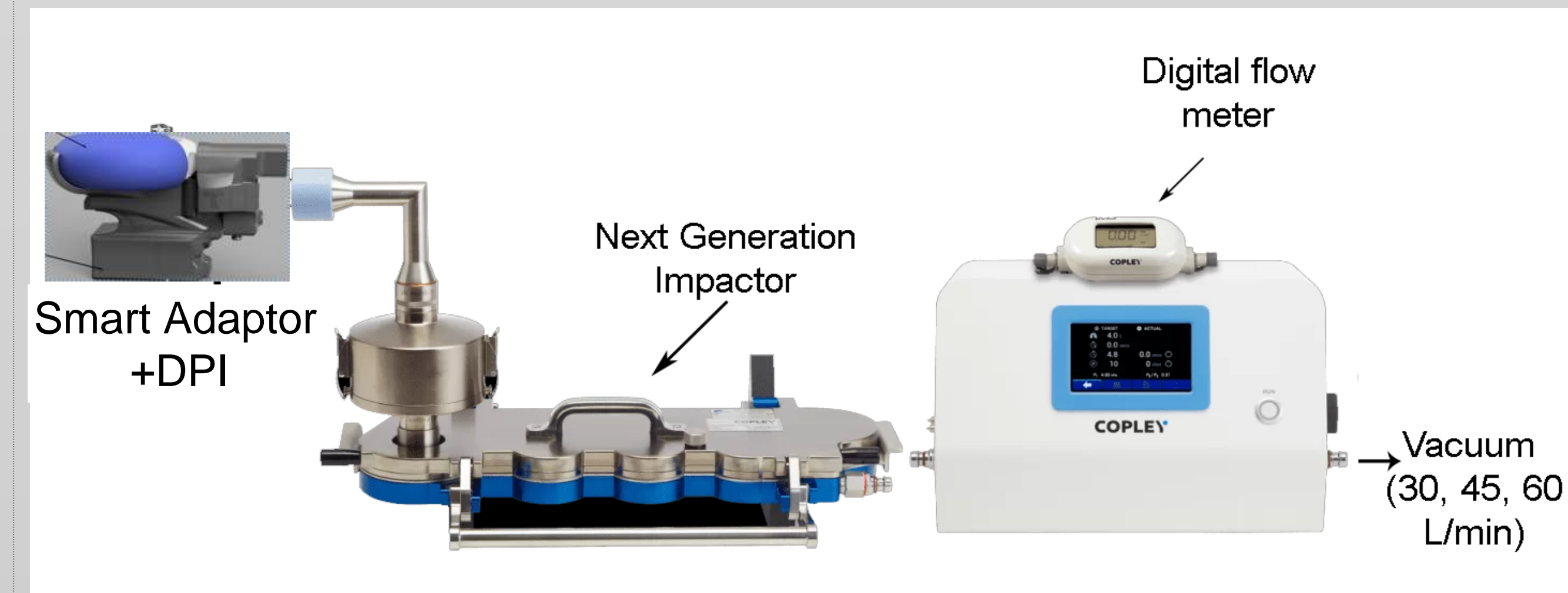


Fig 4: NGI studies used to test our smart adaptor.

RESULTS

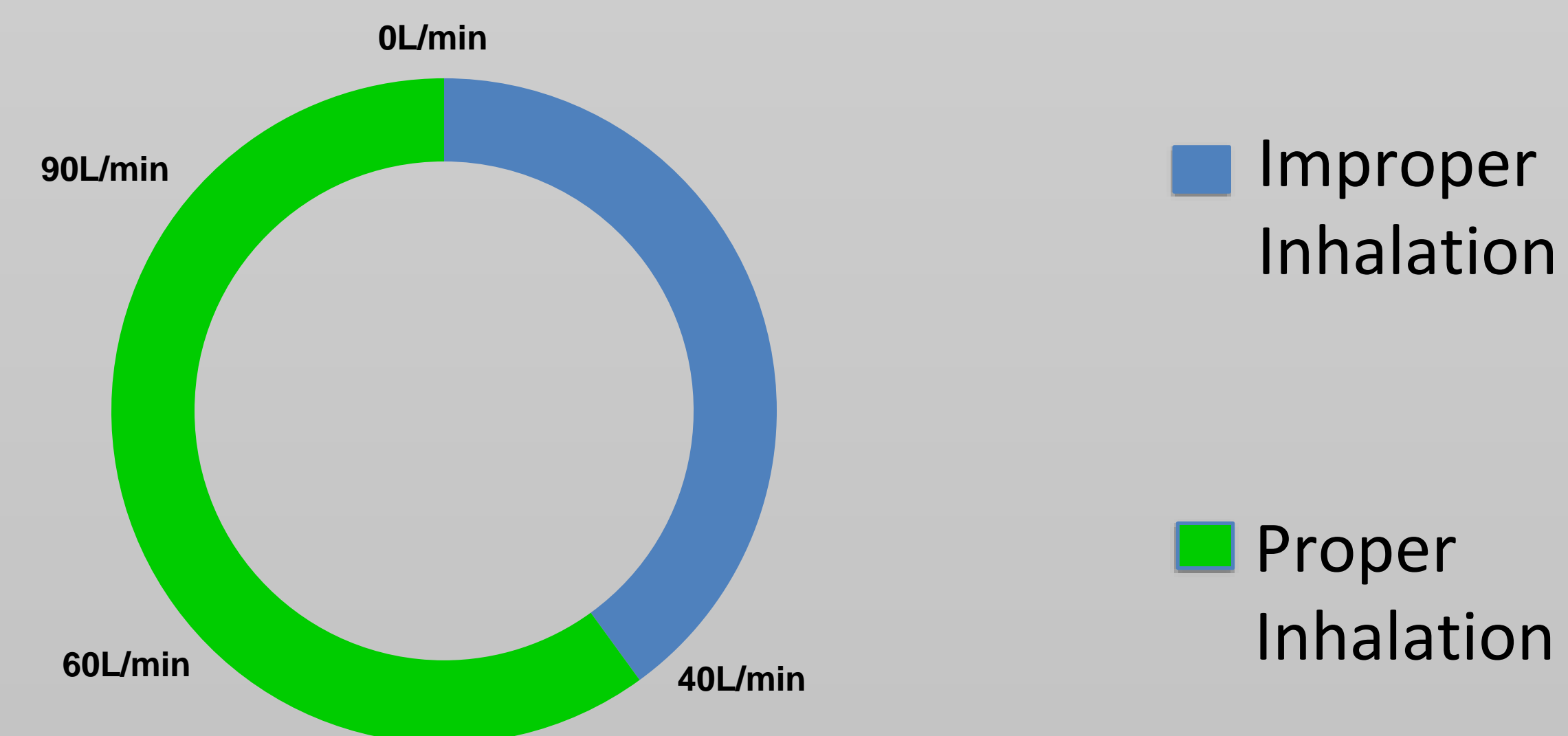


Fig 5: Correlation between air flow rate and smart adaptor color variation.

RESULTS

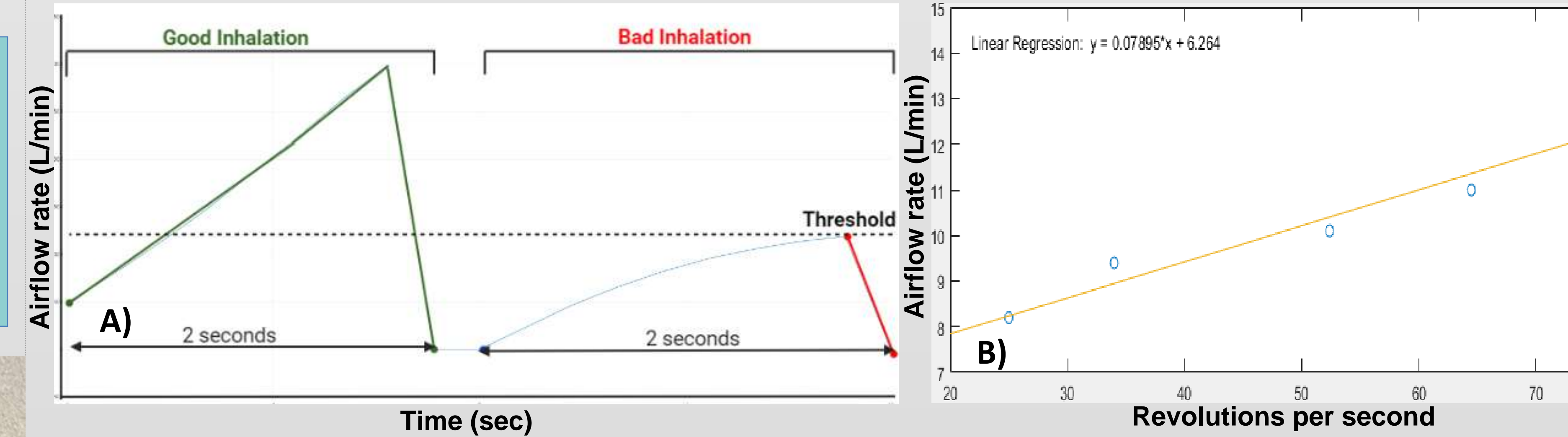


Fig 6: A) The smart adaptor provides a visual depiction of the inhalation maneuver (effective or ineffective inhalation).
 B) There is a direct relationship between airflow and RPS (revolutions per second) as shown by the linear regression.

Our device was made using 3D printing technology and is affordable, priced at only \$34, making it a more economic option compared to similar devices in the market that range from \$80 to \$300.

CONCLUSION

The Cost Benefits of 3D Printing Technology

Our device was made using 3D printing technology and is affordable, priced at only \$34, making it a more economic option compared to similar devices in the market that range from \$80 to \$300.

Future Directions

- Strategically placing the fan in the optimal position to aid patient breathing.
- Test the device for safety compliance according to FDA standards.
- Clinical trials in UNM CTSC.
- Reduce bulkiness.
- Application development to improve user interface, and to store and analyze data.
- AI involvement to guide patients through the inhalation process and act as a virtual doctor.
- Transforming our smart DPI adaptor into a universal adaptor, giving patients the freedom to use it with any type of inhaler.



Multidisciplinary team



App development and AI

Acknowledgment

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- The UNM HSLIC is contributing to 3D print the smart adaptor.

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