

# Performance of Open Oxygen Mask Design vs Conventional Oxygen Delivery Devices: A Simulation Study

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## Background

Oxygen therapy is frequently used in acutely and chronically ill patients presenting with hypoxemia. A new open oxygen mask design was introduced in 2021 (Open mask A). The manufacturer claims that the mask “...provides one solution for all your oxygen delivery needs across your patients' continuum of care, instead of requiring multiple devices for changing flow needs.” The new oxygen mask specifies flow (1-15 L/min and flush) with an expected FiO<sub>2</sub> from 0.25-0.85. This suggests that this mask eliminates the need for multiple oxygen delivery devices as a patient’s FiO<sub>2</sub> requirements change. This study aimed to describe the FiO<sub>2</sub> performance of the new open oxygen mask and other commonly used oxygen masks.

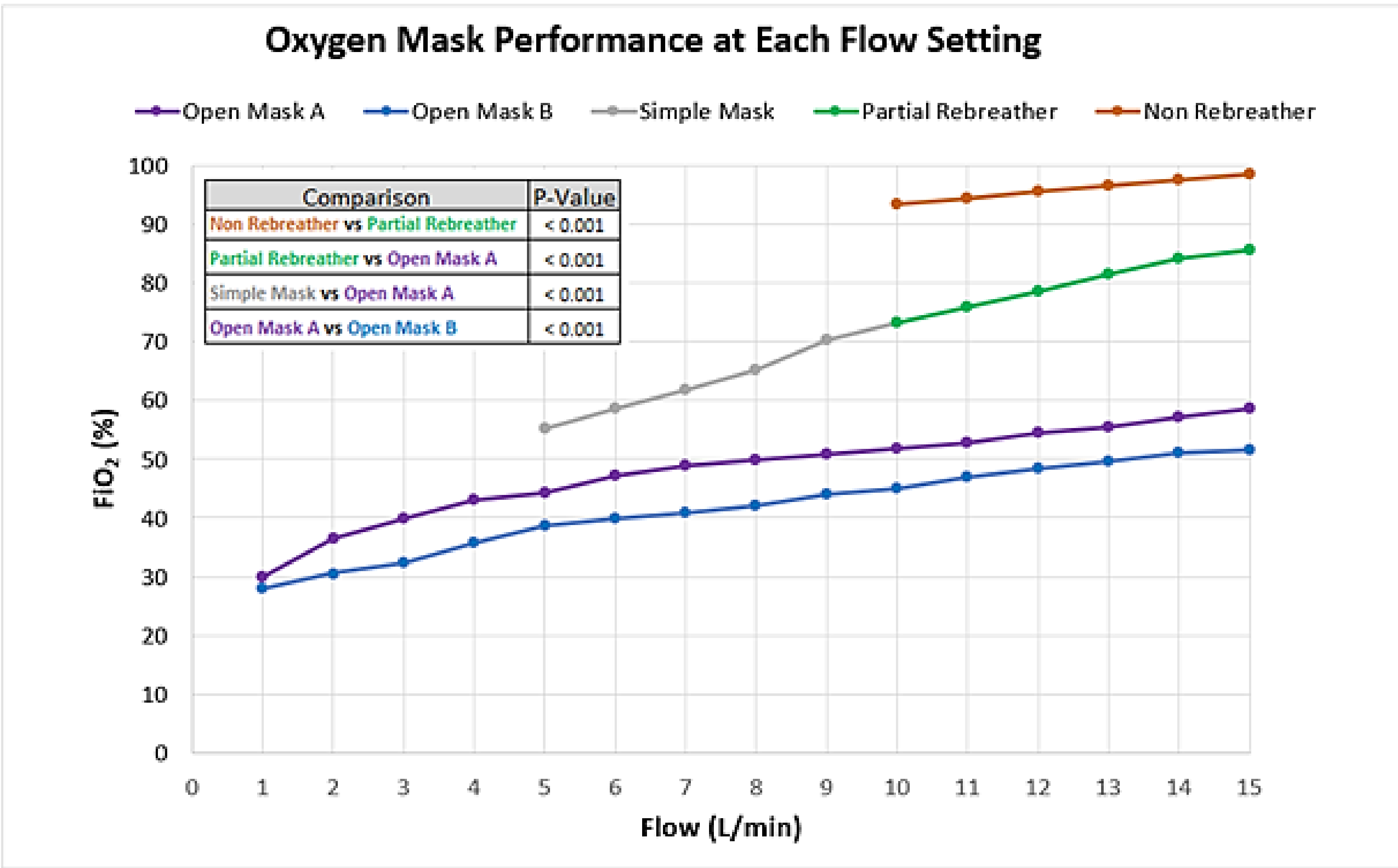
## Methods

The following oxygen masks were studied: Open mask A (AirLife Open; Vyaire), Open mask B (OxyMask; SouthMedic), simple mask (Vyaire), partial rebreather (Vyaire), and non-rebreather (Vyaire). An adult mannequin head was attached to a breathing simulator, which recorded FiO<sub>2</sub> at the simulated alveolar level. The simulator was set to a closed loop volume control mode: VT = 320 mL, C = 50 mL/cm H<sub>2</sub>O, R = 4 cm H<sub>2</sub>O/L/s, f = 15, increase = 25%, hold = 0%, release = 30%.

Oxygen was run through each mask at the recommended flows. Each flow was verified with a flow analyzer before attaching the mask for oxygen measurement. Each experiment was performed twice. The FiO<sub>2</sub> measurements were averaged and compared using a two-way ANOVA with p<0.05 indicating significance.

## Results

Measured FiO<sub>2</sub> was different between all masks when compared at the same flow (p<0.001). The measured FiO<sub>2</sub> range was: Open mask A 0.30-0.60; Open mask B 0.28-0.64, simple mask 0.55-0.73, partial non-rebreather 0.73-1.0, non-rebreather 0.93-1.0. For the Open mask A and Open mask B, the measured FiO<sub>2</sub> fell within the lower end of the expected FiO<sub>2</sub> range. The FiO<sub>2</sub> measured from the Open mask A and Open mask B (set to flush) was lower than the expected upper value (20% for Open mask A and 26% for Open mask B). The measured FiO<sub>2</sub> for the non-rebreather, partial rebreather, and the simple mask were all above the expected FiO<sub>2</sub> range.

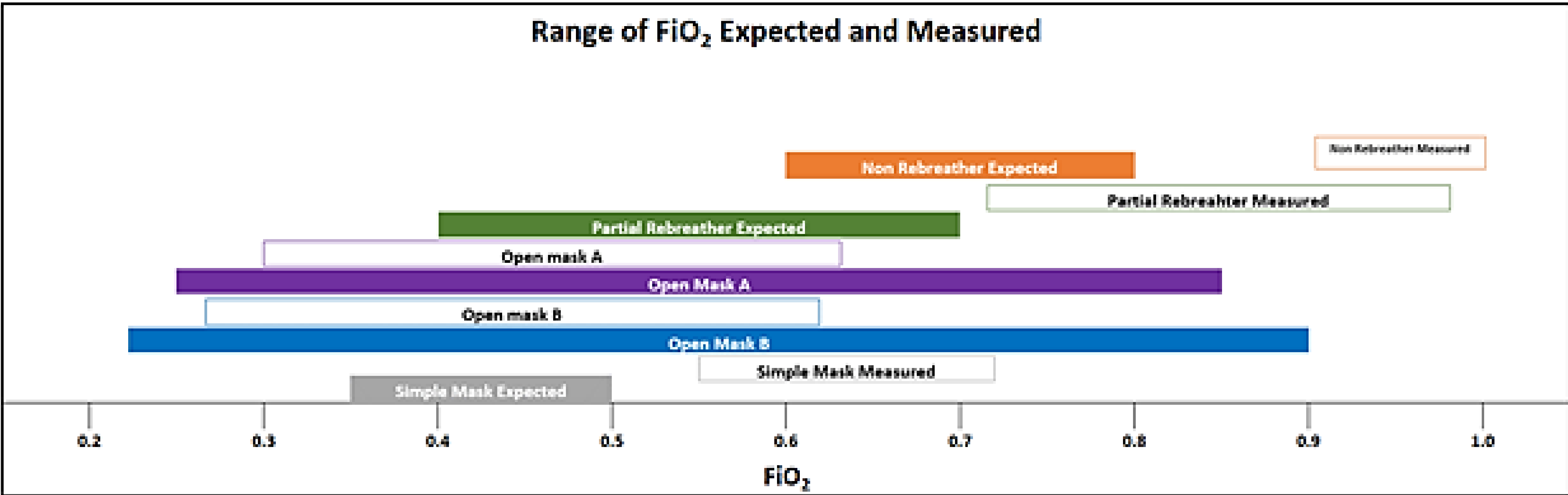


## Conclusions

This study confirms that FiO<sub>2</sub> delivery differs significantly among flow adjustable oxygen mask devices. Furthermore, the measured FiO<sub>2</sub> of all oxygen masks varied from their expected performance. In-depth knowledge of the oxygen delivery capabilities of each mask will help a clinician in selecting an appropriate mask to meet their patient’s oxygen requirements.

These findings suggest that for an adjustable flow oxygen mask, there is not one mask that can supply the full range of FiO<sub>2</sub> delivery. The oxygen concentration delivered with these devices is dependent of a patient’s inspiratory flow, which will alter FiO<sub>2</sub> delivery in the clinical setting.

This study reiterates that after selecting the most appropriate device, oxygen flow to the device is best titrated using SpO<sub>2</sub> or blood gas measurements.



## Disclosures

Conflicts of Interest: Morgan Sorg : none; Robert L. Chatburn: Consultant for IngMar Medical, Vyaire Medical, Inovytec, Temple, Aires, Ventis Medical, and Promedic Consulting.