Validating and comparing efficacy of supplemental oxygen delivery via four commercially available face masks

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Objectives

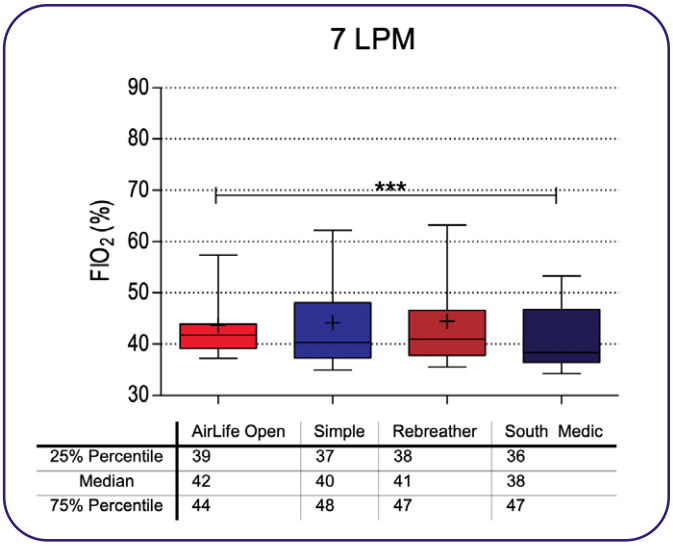
While closed simple oxygen masks deliver oxygen at high flow rates, the actual FiO_2 received varies. Open oxygen masks allow increased comfort for the patient, improved communication and feeding, and higher clearance of carbon dioxide. This was an in vitro study of two open masks (Vyaire AirLife™ Open, Southmedic OxyMask) and two closed masks (both Vyaire Medical) at a variety of oxygen flow rates and tidal volumes in a simulated lung.

Study methods

We tested three sizes each of four different types of masks. Masks were applied to dedicated head models that had internal tubing to simulate the nasal and oral cavities. The masks were attached to an adjustable oxygen supply. The nasal and oral tubes joined together and led to an ASL 5000 lung simulator and simu-lated tracheal FiO_2 was continuously measured using an O_2 sensor. Tests were repeated for oxygen flow rates between 1 and 15 LPM using simulated lung conditions. Each mask was tested nine times for 60 seconds per flow rate after 60 seconds washout.

Results

At oxygen flow rates of 1 and 3 LPM, the open masks were able to deliver incremental FiO_2 in excess of room air. At higher flow rates, the median FiO_2 measured was similar across all masks, although the variability in measured FiO_2 was significantly lower in the Open Mask than that seen in the closed masks ($p<0.001$). Variability in FiO_2 was also significantly related to flow rate ($p<0.001$) in all masks but less prominently in the AirLife Open Mask. These patterns were seen in normal and obstructive lung settings.



	AirLife Open	Simple	Rebreather	South Medic
25% Percentile	39	37	38	36
Median	42	40	41	38
75% Percentile	44	48	47	47

Measured FiO_2 by mask type at 15 LPM. Black horizontal lines represent median of the data. Each box represents the interquartile range (IQR). Upper and lower whiskers represent 1.5 times IQR. ***=p<0.001

What is an open mask?

Open oxygen masks have gained popularity due to their ability to deliver a consistent and reliable FiO_2 at various flow rates with improved patient comfort, reduced rebreathing of carbon dioxide, and reduced hospital costs. Specifically, these devices can be used at a flow of 1–15 L/min to deliver 24–90% oxygen and were designed with one or more large openings to help clear carbon dioxide efficiently and prevent rebreathing. Additionally, the large holes were designed to improve activities of daily living by allowing the patient to drink and communicate.

Vyaire AirLife™ Open Mask

Take home message

The AirLife™ Open offers improved patient comfort and delivers oxygen at precise levels that are comparable to simple oxygen masks with decreased variability. The AirLife Open mask can be used at very low flow rates (<5 LPM) while the closed masks cannot and there is no risk of CO_2 rebreathing with the open mask.

AirLife Open mask delivered significantly higher FiO_2 than the Southmedic Oxymask. The open masks delivered FiO_2 that was similar to that seen in the closed masks as flow rates increased beyond 5 LPM. There was a significantly higher variability of FiO_2 in the closed masks compared to the open masks at higher oxygen flow rates.

GLOBAL HEADQUARTERS

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