

OXYGEN AND AIR TRAVEL

A CLINICIAN'S GUIDE

Background

On July 12th, 2005 the Federal Aviation Administration (FAA) published *Special Federal Aviation Regulation* (SFAR) 106 in the Federal Register (vol. 70, no. 132). The new regulation provides the airlines, passengers and device manufacturers with the rules for use of portable oxygen concentrator systems (POCs) onboard aircraft. The rule became effective August 11th, 2005 and is expected to have a major impact on travel for long term oxygen therapy (LTOT) users. Conservative estimates suggest this new ruling will add more than 50,000 new air travelers annually. As more LTOT travelers hit the skies, more questions will develop regarding the effects of altitude on persons with lung disease and those requiring supplemental oxygen at ground level.

This document was developed to provide clinicians with basic information regarding the potential physiologic effects of altitude on persons with lung disease.

Clinical & Technical Considerations

Oxygen inside the cabin during flight. The partial pressure of oxygen in the ambient air is a product of the barometric pressure and the atmospheric fraction of oxygen (0.209) as represented in the equation: $\text{Barometric Pressure} \times 0.209 = \text{Atmospheric } P_{O_2}$. At sea level this is represented as: $760 \times 0.209 = 159 \text{ mmHg}$. Most commercial aircraft cabins are pressurized to an altitude of approximately 5,000 - 8,000 feet. At 8,000 feet, the partial pressure of O_2 in the cabin is $564 \text{ mmHg} \times 0.209 = 118 \text{ mmHg}$. Gas density at 8,000 feet is almost 30% lower than sea level. With less driving pressure available, the net clinical effect at the interface of the alveoli and pulmonary capillaries is that similar to breathing approximately 15.1% O_2 at sea level.¹

Predicting blood oxygen levels at altitude. There is no single, evidenced-based, standardized method of predicting blood oxygen levels at altitude, especially for patients with chronic lung disease. As a general rule of thumb, it is estimated that inspired P_{O_2} declines approximately 5 mmHg per 1,000 feet ascended. There is no such general rule governing potential changes to SpO_2 at altitude. A number of predictive, regression equations have been derived from various clinical studies yet may not prove accurate or effective as part of an individual patient evaluation for predicting blood oxygen levels during flight.^{2,3,4} A hypobaric challenge (i.e., having a patient breath 15.1% gas) while at sea level may prove to serve as an effective predictor of blood oxygen levels during flight but may not be practical for many outpatient offices to perform.

LTOT patients and air travel. For patients prescribed LTOT for use at home, there is no evidenced-based or expert consensus guideline for prescribing oxygen for use in flight. A patient's baseline hypoxemia, oxygen prescription at ground level, respiratory reserve, level of hemoglobin and general clinical condition prior to flight are all key variables influencing in-flight oxygen use. In his paper titled "Oxygen and Air Travel" published in *Respiratory Care*, Stoller notes that despite the protean effects of altitude exposure, relatively brief exposure to altitude (i.e., <12 hours) encountered during commercial flight seems to be well tolerated, even among patients with chronic lung disease.⁵ It is generally accepted that patients with a ground level PaO_2 of >80 mmHg will experience no difficulty during flight and patients with a PaO_2 of <60 mmHg at ground level will need oxygen at altitude. Patients predicted to have an in-flight $PaO_2 \leq 50 \text{ mmHg}$ are clearly candidates for using supplemental oxygen during flight.⁵ Depending on their clinical condition at the time of flight and their baseline (ground level) supplemental oxygen corrected PaO_2 , some LTOT users may need to increase their oxygen dose (i.e., flow setting or setting on the oxygen conserving device) to ensure adequate oxygenation during flight. The decision to prescribe oxygen during flight or to alter a patient's ground level oxygen prescription for use during flight is one best made by the patient's attending physician. **Therefore, it is recommended that all patients with chronic lung disease be seen and evaluated by their physician prior to scheduling any air travel.**

¹ Seccombe LM, et al. "Effect of simulated commercial flight on oxygenation in patients with interstitial lung disease and chronic obstructive lung disease." *Thorax* 2004 Nov;59(11):966-70

² Mortazavi, A, Eisenberg, MJ, Langleben, D, et al. Altitude-related hypoxia: risk assessment and management for passengers on commercial aircraft. *Aviat Space Environ Med* 2003; 74:922

³ Dillard, TA, Moores, LK, Bilello, KL, Phillips, YY. The preflight evaluation: A comparison of the hypoxia inhalation test with hypobaric exposure. *Chest* 1995; 107:352.

⁴ Gong H, et al. Hypoxemia altitude simulation test: evaluation of patients with chronic airway obstruction. *Am Rev Respir Dis* 1984;130(6):980-986

⁵ Stoller JK. "Oxygen and Air Travel". *Resp Care* 2000 Feb;45(2):214-221

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SUGGESTED READING AND HELPFUL INTERNET LINKS

Peer Reviewed Manuscripts

1. Stoller JK. "Oxygen and Air Travel". *Resp Care* 2000 Feb;45(2):214-221
2. Seccombe LM, et al. "Effect of simulated commercial flight on oxygenation in patients with interstitial lung disease and chronic obstructive lung disease." *Thorax* 2004 Nov;59(11):966-70
3. Akero A, et al. "Hypoxaemia in chronic obstructive pulmonary disease patients during a commercial flight." *Eur Resp J* 2005; 25(4):725-730
4. Johnson AOC. "Chronic obstructive pulmonary disease • 11: Fitness to fly with COPD." *Thorax* 2003 Aug;58:729-732

Links for Additional Information on Oxygen and Air Travel

www.inogen.net

www.thoracic.org/chapters/california/publications.asp

www.aarc.org