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# Patients with lung disease

*Fit to fly?*

## Background

Commercial air travel is cheap and accessible. Many patients living ever better lives despite chronic lung disease wish to, and do, fly. Statistics tell us that misadventure is rare and that flight must be safe for the majority of people.

## Objective

To assist the general practitioner in assessing and advising patients with lung disease on issues relating to the risks associated with air travel.

## Discussion

An aircraft cabin is a low pressure, hypoxic environment that challenges those with lung disease for up to 15 hours at a time. Patients with very poor performance status or severe lung disease should not fly or must fly with oxygen. Selected patients with moderately severe COPD or other chronic lung disease will benefit from specialist review and cabin hypoxia simulation. The risk of venous thromboembolism can be reduced if the patient is risk stratified and simple interventions applied. Perhaps the most important principle is that patients must be clinically stable at the time they fly.

**Keywords:** travel medicine; respiratory diseases; oxygen/therapy



Between 1976 and 2008, the number of Australians travelling overseas increased six-fold. Every day, over 16 000 Australians travel overseas and there are 120 000 domestic passenger movements.<sup>1,2</sup> Among potential travellers with the means and desire to fly are many who are enjoying longer survival with chronic lung disease, often with significant comorbidity.

Air travel is incredibly safe. A recent estimate is that medical incidents occur at a rate of 12 per million passengers flown, with a small number being serious. However, the rate of events is thought to be increasing.<sup>3</sup> Compared to the number of events and flight diversions, the number of deaths is very low, 0.1 per million passengers flown.<sup>4</sup> Details provided about deaths are generally scant, but in a review of flight related events in Australia, half the deaths were attributed to cardiac causes, and respiratory events are infrequently described.<sup>5</sup>

When many can be considered at risk and few suffer harm, there is a temptation to ignore the problem completely. This would be unwise. Instead, the challenges that face the general practitioner include:

- to be reasonably informed of the nature of the commercial aircraft environment and the challenges it poses for patients contemplating travel
- to be confident in answering the questions posed by the majority of patients who can look forward to quite safe travel
- to select patients who might benefit from further specialist assessment.

The commercial aircraft cabin is an interesting environment. It is pressurised with compressed ambient air taken from the intakes of the jet engines. This air source creates a small risk of contamination with fumes from engine lubricants. To this is added some recirculated air without which cabin humidity would be intolerably low. The external air is superheated and the recirculated air HEPA filtered, eliminating risk of microbial contamination from new cabin air. In functional terms, the cabin is akin to the negative pressure rooms that tuberculosis patients are placed in during hospital care. There is some risk from droplet spread, but arguably a greater risk of transmission of respiratory viruses from fomites and surface contacts.



Cabin air pressure falls as an aircraft ascends to cruising altitudes but must, by regulation, not fall below that seen at an altitude of 8000 ft (2440 m), equating to a 25% fall below sea level pressure. This creates two issues. First, gas within a closed cavity, such as the middle ear, sinuses, a poorly communicating bulla or a pneumothorax, will expand. Second, the falling pressure causes an equivalent fall in inspired oxygen levels. A typical  $pO_2$  in normal subjects is 60–65 mmHg when awake and somewhat lower if asleep.<sup>6</sup> Clearly this is well tolerated.

On a short haul flight, cabin pressure changes occur quite rapidly but, when the time taken to reach and descend from cruise altitude is taken out, relatively short periods under hypoxic conditions are experienced. Long haul aircraft are designed to have a higher cabin pressure at equivalent altitude. Changes in cabin pressure occur more slowly because some fuel has to be burnt off before higher cruise altitudes can be reached. A recent survey<sup>7</sup> concluded that the average cabin pressure during intercontinental flights on a Boeing 747 aircraft is higher than that in Davos, a Swiss alpine village where for the past 150 years patients with advanced lung disease have travelled for recuperation and treatment. The fact that oxygen levels are significantly better than the minimum specified may provide an important margin of safety for higher risk passengers.

## General aspects of travel planning

There should be no compromise on the principle that a patient must be clinically stable at the time of travel. Best management in some situations will require deferral of a planned flight and it is wise for the patient to purchase an airfare that has some flexibility. If not, the pressure to fly when unwell may be great. Consider the destination, not just the flight! What is the altitude? Will heat or humidity be oppressive and cause cardio-respiratory compromise or make enjoying the travel experience impossible? Is the patient travelling to a country with an influenza epidemic?

Consider health care and the travel insurance issue. Does the country being visited have a reciprocal health care agreement with Australia?

The cost of an insurance policy that covers the known condition may be prohibitive, but a traveller should be advised to discuss with their travel advisor the option of a policy that at least covers other travel accidents and unrelated illnesses. It is wise to consider the potential need for oxygen early in the course of travel planning.

Policies and the costs of oxygen supply vary between airlines. Many airlines will allow portable oxygen concentrators to be used in flight. For patients travelling some distance, this solves the problem of oxygen supply at the destination as well.

## Asthma

Air travel is safe. Almost all reported in flight events that relate to asthma are in passengers who forgot to pack their asthma reliever. All inhaler devices work effectively in cabin conditions. Where there has been a significant exacerbation of asthma within 48 hours of intended flight, travel should be delayed. Attention should also be paid to treatment of associated allergic rhinitis to reduce the risk of sinus or ear pain. For patients with severe chronic asthma, assessment should follow the principles of that of COPD.

## COPD and restrictive lung disease

There must be an enormous number of patients who are flying with COPD without any consideration of risk and with little more than a mild excess of breathlessness reported when surveyed. The extent of risk for the majority of patients with COPD should not be overstated. There are in excess of 500 000 Australians living with moderate or severe COPD,<sup>8</sup> an uncertain but significant number of whom fly each year. In selected patients, simulation of cabin conditions either in a low pressure chamber or by the inhalation of hypoxic gas mix is indicated. The problem is that, when such simulations are conducted, many patients who have flown uneventfully without oxygen are shown to have hypoxemia that would be clinically concerning in other settings.<sup>9</sup>

In actual flight, and when cabin pressure conditions are simulated, the best predictors of oxygen desaturation are poorer lung function and baseline oxygenation.<sup>9,10</sup> Reasonable thresholds for lung function are  $FEV_1$  less than 50% for obstructive lung disease and vital capacity less than 70% for restrictive disease. While hypoxia and symptoms can be reasonably predicted, severe events and harm cannot be. The numerator (events) is small and the denominator (passengers at risk) is large but unknown and sensible risk estimates for any individual are incalculable. In patients with COPD, low flow supplemental oxygen corrects the hypoxaemia.<sup>11</sup>

A practical issue is that there is simply not the laboratory capacity to conduct hypoxia challenges on all travellers assessed as needing them in some published guidelines. A pragmatic approach is required

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## Case study

Maureen, 55 years of age, is a teacher in excellent health who is planning a trip to Asia that will include two 10 hour flights and a series of 1–2 hour flights. Some of the areas she is travelling to have poor medical care. She recently experienced right sided chest discomfort on a flight from Hobart to Sydney and chest X-ray shows a single large bulla occupying half of the right hemithorax. No old X-rays are available. Spirometry is in the lower part of the normal range.

Question 1. What will happen to the bulla during flight and what are the flight risks?

Question 2. Does her destination affect your advice to her?

Question 3. What would you advise her in relation to travel?

**Table 1. General guidance for the evaluation of flight safety in patients with chronic lung disease**

Patients on long term oxygen – hypoxemia does not correct with oxygen – pO <sub>2</sub> <55 mmHg or SaO <sub>2</sub> <88% at sea level	Should not fly on commercial aircraft, even with supplemental oxygen
Patients on long term oxygen – hypoxemia corrects with oxygen	Risk of symptomatic in flight events without supplemental oxygen is very high. Fly with oxygen and increase the flow rate by 1–2 L/min <sup>1</sup>
Resting SaO <sub>2</sub> <92% or unable to walk 50 m without stopping	Very likely to require supplemental oxygen to maintain what would generally be regarded as reasonable oxygenation, but the risks of flying without oxygen are uncertain. Hypoxia challenge test may be useful to convince the patient of the need for oxygen
Impaired exercise capacity – SaO <sub>2</sub> 92–95% (eg. unable to walk up railway steps without stopping)	Consider specialist referral for hypoxia challenge test. Interpretation of this result should take into account the degree of hypoxemia seen and associated symptoms
Good exercise capacity – SaO <sub>2</sub> 92–95%	Flight is almost certainly safe. Consider a detailed evaluation in some cases where there is significant cardiac or other comorbidity
Good exercise capacity – SaO <sub>2</sub> >95%	Flight is safe. No further evaluation is needed

and is described in the *Table 1*. In time, larger surveys and prospective studies will be conducted so that such advice can be better based in evidence. We have a lower threshold for recommending oxygen in patients with clinically significant cardiac disease.<sup>12</sup> One consistent observation is that in-flight hypoxemia is worsened further when an exercise task similar to walking to the aircraft toilet is added. Because of this, we suggest that patients taking short flights should use the bathroom shortly before they board the aircraft.

### Pneumothorax and bullous lung disease

Air contained within any closed space will expand by up to 25% during flight and will do so more quickly on short flights. Therefore, this is the reverse of the situation with chronic lung disease and venous thromboembolism (VTE) where longer flights generate greater concern. There is a risk of rupture of a large lung cyst or bulla and death from cerebral gas embolism has been described. Patients with advanced cystic lung disease should discuss their individual risk with those involved in their specialist care. A remote history of pneumothorax does not constitute a flight risk when there is no other lung disease. If the lung is fully inflated 14 days after a recent traumatic pneumothorax, flight is considered safe.<sup>13</sup> Pneumothorax treated with pleurodesis is very unlikely to recur but travel should be delayed 6 weeks after resolution of a spontaneous pneumothorax treated conservatively. The risk of recurrence of a spontaneous pneumothorax within a year of the first event is high enough that travellers should consider carefully travel to remote areas or

where quality medical services are not accessible.<sup>14</sup> The assessment of flight risk in a patient with a chronic pneumothorax is a specialist task. Relevant considerations would include its size, the extent of fibrosis around the pneumothorax, and severity of any underlying lung disease.

### Recent cardiac and thoracic surgery

There should be a period of 6 weeks after surgery before a routine flight, assuming that the clinical course has been uneventful and there are no other active issues.<sup>13</sup> Where there is a pressing need to fly before that time has elapsed, there would ordinarily be a discussion between the medical team and airline medical advisers. Individual patient factors and knowledge of the intended flight details will be critical in making that decision.

### Venous thromboembolism

Long distance flight causes deep vein thrombosis (DVT) and pulmonary embolism (VTE). This risk is concentrated in longer flights; with the risk increasing the longer the journey.<sup>15</sup> For those at average risk, routine advice as provided at the beginning of most flights is adequate. Hydration should be maintained, alcohol and caffeine limited and simple leg exercises performed. For those at higher than average risk – current malignancy, obesity, pregnancy or very limited mobility, a remote history of DVT associated with a clear trigger or another VTE risk, knee length graduated compression stockings should be added. For passengers with multiple risks or who have recently ceased

## Case study answers

1. The bulla will expand during flight by up to 25%. There is a significant risk of barotrauma – pneumothorax or pneumomediastinum. Fatal cerebral gas embolism has been seen in similar patients.
2. It must be considered. The quality of care may be deficient and there will be practical problems in repatriating her if she does survive barotrauma. Many travel insurance policies will not cover these costs.
3. Short and long flights both have real risks. She should not fly until she has had specialist review. If the bulla can be safely excised, flying will be safe after recovery.



anticoagulation for VTE, a single dose of low molecular weight heparin before each flight of more than 4 hours duration should be considered. This is superior to both aspirin that has no effect, and placebo in preventing VTE.<sup>16</sup>

## Obstructive sleep apnoea

Air travel is safe for patients with well controlled obstructive sleep apnoea (OSA). It is advised that they travel with their CPAP device, and these are now light enough for this to be practical. If on an overnight flight, portable machines can be used on many airlines. Abstaining from alcohol should be advised for patients with known or suspected OSA. In patients who have untreated or undiagnosed OSA there is a real risk of the cumulative sleep deficits from OSA and jet lag contributing to a higher risk of traffic or other accidents. Patients should be strongly counselled not to drive or operate machinery while fatigued or sleepy after travel.

## Emergencies in flight

The explosive decompression of an aircraft interior can occur as seen in 2008 with the damage to a Qantas 747 flying from Hong Kong to Melbourne. Skilful action of the aircrew saved the plane and the passengers on that occasion. In circumstances of an explosive decompression, the time that an able person has to act is less than 20 seconds.<sup>17</sup> This period is aptly described as the actual time of usable consciousness. In that rare event, when oxygen masks are deployed, it is critical that the able or adult passenger fix their oxygen mask first – as in every aircraft safety briefing. An ineffective attempt to help another passenger will leave both disabled until the plane has completed its emergency descent. In those 4 minutes, unnecessary harm can be caused to the unwell passenger.

## The desperate patient

From time to time, we encounter a patient who is prepared to accept 'any risk' to travel long distances – sometimes to a place where a novel treatment is available and sometimes to see relatives for what might be the last time, or, to 'go home to die'. Some patients are at a stage in their illness where risks seem immaterial. Airlines have a right to be concerned about carrying these patients because the airline effectively assumes a large risk. Deaths in flight are extremely traumatic for flight crew and a serious medical deterioration may require that a flight be diverted at great cost and inconvenience to the airline, crew and other passengers. In these cases, GPs should talk honestly to the airline's medical officer who is well informed and will try to accommodate the passenger when reasonable. However, it must be recognised that it is the captain who has ultimate responsibility and the final right to refuse to carry a passenger.

## Conclusion

Commercial flight is safe for nearly all patients with lung disease. Simple and practical travel advice with leniency in some areas but rigid adherence to key principles in others will lead to good outcomes for all.

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