

Key points

- Patients who require medical oxygen for air travel should begin planning their trip as far in advance as possible.
- It is very advantageous for healthcare professionals to be able to advise patients on travelling with oxygen and what they need to do.
- Requirements and policies can vary greatly between airlines, causing problems for patients who are trying to book their flights.
- Patients or their carers need to be confident operating their oxygen equipment, as the stress of travel and lack of medical assistance on an airplane can put them at risk.
- Careful arrangements need to be made by the patient to make sure that they have the correct oxygen therapy at their destination, and can access support if they need it.

Educational aims

- To understand the process and potential challenges for a patient who requires oxygen to travel by plane.
- To be confident in discussing air travel with patients who are affected by lung disease.



Review

Why is medical oxygen a challenge for people travelling by air?

There are currently 3.5 million people in Europe who require medical oxygen, and as life expectancies increase, this figure is likely to grow. At the same time, air travel is becoming more accessible to a wider range of people, as costs of flights fall, and airlines and airports make improvements to the accessibility of their services.

People who need medical oxygen to fly experience a wide range of difficulties when planning to travel by plane, and sometimes during or after the flight.

A European Commission Regulation (EC No 1107/2006) sets the standard for airlines when it comes to making air travel accessible, but healthcare professionals and oxygen providers can both help patients to navigate the various requirements for using medical oxygen when travelling.

In this review, we discuss the journey of the patient planning to travel by air, from initial consultation and fit-to-fly test, through to planning their air travel and oxygen supply, travelling, and arriving at their destination. We also highlight some common problems at each stage and suggest points for healthcare professionals to discuss with patients.

Introduction

Globally, the number of people using medical oxygen for respiratory conditions is increasing. There are 3.5 million people in Europe who need oxygen [1], and as people get older there will be more people living with chronic disease and more disabilities, meaning this a growing problem. In parallel, air travel is becoming more accessible for a greater range of people as the cost of tickets fall, and working and living styles change. However, there are still many barriers to air travel for passengers who need to use medical oxygen to fly, and a successful journey is contingent upon careful planning and support from both healthcare professionals and oxygen suppliers.

Difficulties associated with air travel for people with respiratory conditions is an equality issue, and is covered by the European Commission Regulation on the rights of disabled persons and persons with reduced mobility when travelling by air (EC No 1107/2006) [2].

This regulation states that:

 "Disabled persons and persons with reduced mobility, whether caused by disability, age or any other factor, should have opportunities for air travel comparable to those of other citizens"



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Airlines have a responsibility to provide equal access to passengers who require medical oxygen, but many barriers remain. Healthcare professionals and oxygen suppliers can help patients plan their journey and reduce the risk associated with air travel. http://bit.ly/30wkCU4

Cite as: Orritt R, Powell P, Saraiva I. Why is medical oxygen a challenge for people travelling by air? *Breathe* 2019; 15: 182-189.

- "Disabled persons and persons with reduced mobility should therefore be accepted for carriage and not refused transport on the grounds of their disability or lack of mobility, except for reasons which are justified on the grounds of safety and prescribed by law"
- "Assistance to meet [disabled persons'] needs should be provided at the airport as well as on board aircraft ... the persons concerned should receive this assistance without additional charge"
- "[Airline] charges should be adopted and applied in full transparency" [2]

As well as travelling for personal and professional reasons, respiratory patients are called upon as patient advocates or speakers to share their experiences at international conferences and events, helping to provide the patient perspective on key topics in respiratory medicine.

Although there are still some respiratory conditions that prevent people from travelling by plane (for example, infectious tuberculosis, untreated pneumothorax and major haemoptysis) most people who require medical oxygen are able to fly.

Many of these individuals will use supplementary oxygen on a full-time or *ad hoc* basis in their everyday lives, but may need to increase the flow rate they receive when travelling by plane due to the reduced oxygen pressure in the cabin of an aircraft. Others who do not require medical oxygen elsewhere may need to use it when travelling by plane.

Conditions commonly associated with use of medical oxygen for air travel include chronic obstructive pulmonary disease (COPD), restrictive and interstitial lung diseases, bronchiectasis, cystic fibrosis and severe asthma. However, any person with a respiratory condition that could cause them to experience difficulties at reduced ambient oxygen levels should use supplementary oxygen when travelling by aircraft.

The percentage oxygen on a plane travelling around 2440 m is equivalent to 15.1% oxygen at sea level [3]. When considering the risk that the reduced partial pressure of oxygen in a travelling aircraft presents, it is useful to refer to the oxygenhaemoglobin dissociation curve. This curve shows the relationship between oxygen saturation of the haemoglobin molecules in the blood and partial pressure of oxygen (figure 1). Due to the sigmoidal shape of this curve, oxygen saturation in a healthy person only drops by about 10%, a decrease that is typically well tolerated [4]. However, in people with existing respiratory difficulties, there is a risk of hypoxia.

Despite commitments made by airlines to provide an equal service to all passengers including those with disabilities, there are still numerous barriers to air travel for people who require supplementary oxygen to fly. One of the biggest hurdles for these individuals is related to bringing their own portable oxygen concentrator



Figure 1 Oxygen-haemoglobin dissociation curve.

(POC) or oxygen cylinders. Airlines must adhere to strict regulations concerning use of portable electric devices and transport of dangerous goods. Due to the relative rarity of airline passengers with respiratory difficulties, airlines have historically been slow to consider the needs of these passengers and agree upon a standardised process and set of requirements.

The European Lung Foundation (ELF) started to work on the issue of air travel for people with oxygen in 2012, and have worked together with the European Federation of Asthma and Airways Diseases Patients (EFA) on the issue ever since [5, 6]. In 2016, ELF conducted a survey to ask people with respiratory conditions and their carers about the barriers they experienced when trying to travel by plane (unpublished survey and workshop by ELF). The results showed that the main obstacle was finding reliable information on airline oxygen policies (19%). Other obstacles experienced by at least 10% of survey participants included difficulties bringing their own POC, the perceived physical impact of travelling by plane, and other concerns related to logistics and planning.

Difficulties with air travel for these individuals are further compounded by stress at the airport and during the flight, extra exertion associated with travel to and around the airport and baggage handling, and immobility and cramped conditions on aircraft.

In this review article, we seek to outline the process through which a person with a respiratory condition can work with their healthcare team, oxygen supplier and airline to plan their journey, travel by plane, and arrange and use oxygen therapy at their destination. At each stage, potential barriers will be identified and examined, and recommendations for assisting a patient in overcoming these barriers will be provided. This article has been written together with EIGA (the European Industrial Gases Association), to provide a practical insight as to why there are so many challenges for people travelling with oxygen and how they can be overcome.

Planning

Timelines

Patients who might be required to use medical oxygen should plan their trip as far in advance as possible, and start the process for assessing and planning oxygen provision as soon as they know when they will be travelling. The time needed for organising air travel with medical oxygen depends on many different factors, so the absolute minimum time needed for planning will vary depending on the individual. As a guide, the process can take around 6 weeks after a patient has been advised that they are medically fit to fly.

Aside from the time taken for medical necessities (including the fit-to-fly test [7] and certificate provision) the factors that cause variation in timelines include: the destination of the patient, communication with the oxygen supplier at the final destination, and the support and requirements associated with the chosen airline.

Initial consultation

On first approaching their general practitioner or respiratory consultant about air travel, the patient should find out about the length of time needed for the fit-to-fly assessment and any other medical necessities, and begin planning their journey as soon as possible before they need to travel.

Patients should also be encouraged to consider other aspects of travelling with a lung condition, including:

- medical insurance
- additional oxygen equipment and batteries
- oxygen therapy at the destination
- compensation for additional expenses associated with travelling, if available from their healthcare provider
- vaccinations
- provision of emergency supplies of medication
- guidance about maximising respiratory performance on the flight (for example avoiding alcohol and sedatives, and strategies to reduce anxiety)

It may be useful to provide the patient with further written information about travelling by plane while using supplementary oxygen. ELF has produced a factsheet for this purpose, which is available in 18 languages and is written in clear, accessible language [8].

Researching airlines

The travelling patient or their carer should be encouraged to ask questions of the airlines they are considering travelling with in advance of booking their flight, to avoid unanticipated setbacks. They should ask about:

- the types of oxygen support devices that are permitted
- the rules surrounding batteries for portable electrical equipment
- any restriction the airline has per person for medical oxygen
- the process for boarding and disembarking
- the information required on their medical certificate
- any other paperwork that is needed

At this stage, it is also advisable to check for restrictions that apply to any other medical equipment or medicines the patient needs to travel with, for example continuous positive airway pressure (CPAP) machines, nebulisers and medicines.

The patient can then make an informed decision about which airline is best positioned to support them before and during their flight.

Fit-to-fly assessment

The assessment to determine if an individual is able to travel by plane and what flow rate of oxygen they will require is known as the fit-to-fly assessment or test. One of the most commonly discussed parts of this assessment is the hypoxic challenge test (HCT), in which an individual is actively monitored over a period of around 20 min while breathing levels of oxygen equivalent to those they will experience in a travelling aircraft.

When the arterial blood oxygen levels are expected to decline below 6.6 kPa while flying (the current recommended threshold for HCTs [9]), consideration of supplementary oxygen is advised. However, there has been mixed evidence for the predictive validity of the HCT in assessing the risk of adverse effects for people travelling by plane [9, 10]. Therefore, this assessment should be considered alongside other factors to determine what level of support, if any, an individual will need in the form of supplementary oxygen.

The patient's full medical history should be taken into account, alongside clinical considerations (including stability of their condition) and information about the patient's previous experiences of air travel. It may also be appropriate to conduct a walking test to further assess dyspnoea.

Finally, individual patient needs should be considered, including: any relevant comorbidities, patient age, general condition and the length of flight they would like to take. The person(s) conducting the assessment should also be confident that the patient or the patient's carer is be able to operate (or learn to operate) medical oxygen equipment safely.

The results of the fit-to-fly assessment should be shared with the home oxygen provider, and the oxygen provider the patient will use at their destination.

Assessments for children and infants

Assessment of infants should take into account prematurity. For infants that were born pre-term, medical oxygen should be considered, particularly if the infant is showing symptoms or has a peripheral capillary oxygen saturation (S_{PO_2}) <85% [11].

For infants and children with chronic respiratory conditions, a full fit-to-fly assessment should be performed, and a specialist respiratory paediatrician should be consulted as part of this process.

Medical certificates

Medical certificates are requested by airlines to prove that the passenger is fit to fly, and to provide details that could be useful for the airline in facilitating the passenger's journey. The requirements for medical certificates differ between airlines, so it is advisable for the person travelling and their healthcare provider to discuss the specific requirements for the airline they will be most likely to travel with.

In addition to the information required by the airline, medical certificates should be specific about the passenger's condition, contain information about any accompanying person or carer, and indicate the required oxygen flow rate. Information about treatment and medication is not always necessary.

Booking flights

After choosing the airline that is best for their travel and medical needs, and speaking to the airline about their requirements, people who need oxygen when they are flying should book their flight as far in advance of the date of travel as possible. When booking, they may wish to consider choosing a seat that is adjacent to the aisle and in close proximity to the toilets. Some airlines will ask for additional information at this stage.

The patient should also share the details of their planned travel with their current oxygen supplier [12], including dates, travel itinerary, mode of travel and final destination. At this stage, their current oxygen supplier will be able to advise whether they will be able to provide oxygen for the duration of travel, or if another oxygen supplier should be sought.

Acquiring medical oxygen for travel

For those who already use medical oxygen, the next step involves contacting their current supplier about their travel arrangements, to plan or acquire additional oxygen for flying and a back-up battery if they are planning on using a POC.

For those who do not already use medical oxygen, their doctor or consultant should suggest an

oxygen supplier to them. The new oxygen supplier will arrange for a technician to visit the individual in their own home and train them or their parent or carer so that they can operate the equipment safely and effectively. The technician should also conduct a risk assessment on their initial visit, and provide written instructions and details of an allhours assistance phoneline.

This is also the time to plan and book oxygen for the destination, if needed. If the current oxygen supplier does not serve the destination country, they may be able to suggest another supplier that does.

The oxygen service provider at the destination is responsible for providing all the required training for the patient in using the equipment that they have provided prior to travel. They are also responsible for providing a back-up service in case of equipment failure.

Planning travel through the airport

It is advisable for the person travelling to contact airport assistance services at both the departure and arrival airports to arrange assistance prior to travel. These services may be able to provide transport around the terminal, wheelchairs and maps, or an in-person guide. They can also help to cater for any other disabilities.

Prior to travel, the journey through the airport should be planned, with particular attention given to where the assistance services are based, where power outlets are located in case of need to charge POCs, and where the toilets are. This process can also help the passenger to plan for the time needed to go through the airport and reach their gate safely and in time for their flight.

Travel to and from the airport should also be planned in advance to avoid unexpected issues.

Problems encountered during planning

Airline regulations with regards to the type of equipment that is permitted on their aircrafts, the use of equipment on board and during take-off and landing, and the paperwork required is highly variable. This is one of the main challenges for people who wish to travel by plane with medical oxygen. Even those that have flown before with similar requirements may find that each new flight presents its own challenges, particularly with respect to the requirements of a new airline.

Another variation is the cost. Some airlines will provide oxygen from the ring main or from their own cylinders free of charge, whereas others charge a lot of money for cylinders and will not allow passengers to bring their own.

A common problem for people who are seeking answers from airlines about travelling with medical oxygen is that they have difficulty finding the right person to speak to. Airline policies and charges are not always clear on websites, and it can be difficult to find the right person to speak to when contacting airlines, particularly if the patient is prone to fatigue. Patients may find it useful to ask their carer or travelling partner to help them, and to make use of online resources such as ELF's airline index to find policies and contact details for the airline they are travelling with [13].

At the airport

Passengers travelling with medical oxygen should take all necessary paperwork relating to their oxygen devices or condition to the airport with them. This will include, but may not be limited to, physical copies of their medical certificate and information about their oxygen device (including instructions and warranty).

Using the assisted services at the airport can improve the experience of the individual, and reduce the fatigue and stress associated with plane travel. Once at the gate, the passenger should make themselves known to the airline employees, and ask to board first or last. They may also require assistance to board, particularly if access to the plane is *via* the stairs.

Problems encountered at the airport

It is important to note that not all operatives at the airport are trained to the same level. Some are employed by the airport, others by the airline, and some may be hired from a contracting agency (for example, security staff). Making contact with assisted services prior to arrival at the airport can increase the chances of receiving appropriate support.

Arriving at the airport can be a stressful experience, which may cause an exacerbation of symptoms. It may also lead to fatigue, which can decrease a person's ability to operate their device safely, and increase their respiratory rate, depleting their oxygen quickly. This stress can be mitigated by thorough planning and a timely arrival at the airport, but unexpected issues may still occur. Delays to flights will also deplete the oxygen supply if cylinders are being used, and this can cause additional stress.

Managing stress and anxiety should be part of the discussions between the person travelling and their healthcare professional prior to travel. Furthermore, a patient that is confident and practised in using and operating their POC will be better equipped to cope with any increases in anxiety at the airport.

During the flight

Types of oxygen that can be used on a plane

POCs concentrate oxygen from the ambient air to provide a supply of oxygen to the user. Therefore, so

Self-evaluation questions

- 1. Why might a person with a lung condition need medical oxygen on a plane, even if they do not require it in their daily lives?
- 2. What options does a patient have for oxygen supply when travelling by plane (oxygen devices, *etc.*)?
- 3. What additional considerations are there in a fit-to-fly assessment for an infant or child?
- 4. What should a patient do if they have a technical problem with their device but do not speak the languages spoken by their oxygen supplier's assistance phoneline operatives?

long as electrical power is not a limiting factor, they are unlimited in the supply of oxygen they provide. Although some aircrafts provide a power supply for passengers, it is strongly advised to carry a spare battery. POCs are the preferred device for many travelling by plane, and many models are accepted by airlines. Passengers usually use their own POC, and so benefit from the advantage of using familiar equipment. However, some airlines require them to be switched off for take-off and landing, because they are classed as a portable electronic device. For this reason, another supply of oxygen may also need to be used.

Cylinders are widely available, but subject to stricter requirements than POCs because of the perceived risks of transporting pressurised gases. They are not permitted on most airlines. However, some airlines will offer to provide cylinders, often for a cost. The passenger must ensure that they have enough oxygen to last them for the duration of the flight, taking into account flow rate and unanticipated delays.

The oxygen supplier can advise on a suitable oxygen supply, or more commonly, a POC for the flight, considering the passenger's required oxygen flow rate as specified in the results of their fit-to-fly assessment.

In some circumstances, passengers may use the ring main on the aircraft for their oxygen supply, which is fed by large cylinders in the aircraft hold. Using this method, there is no limit to the oxygen supply for the passenger, and the need for extra equipment in the cabin is removed. However, the flow rate may not be appropriate.

The length of the flight will determine the amount of supplementary oxygen required, and longer flights are associated with greater risk for passengers using supplementary oxygen because of the limited battery life and limitations in taking a backup battery.

Problems encountered during the flight

The main issue associated with using a POC for oxygen support while flying is battery life. Passengers should take the opportunity to recharge

their device and any spare batteries before take-off, in the terminal if possible.

If the flight takes longer than expected, is delayed before take-off or landing, or passengers are held on the plane for any reason, the oxygen supply needs of the patient will increase. For this reason, individuals should carry a back-up battery for their POC or more oxygen than they anticipate using during the flight.

There is no possibility of contacting oxygen supplier assistance phonelines during the flight, and flight attendants typically do not have expertise in assisting patients using these devices. Any problems with the oxygen devices will have to be dealt with by the patient or their carer, which is why the manual or operating instructions should be kept accessible during the flight. It is also important to note that there is negligible risk to other passengers when the oxygen devices are used in accordance with the instructions.

It is useful for patients to remind flight attendants that they need to disembark first or last at the end of the flight.

At the destination

The same considerations apply at the destination airport as for the departure airport, including use of airport assistance services and planning onward travel. The patient should have arranged for a delivery of medical oxygen at their destination, and they should make their way to the arranged drop-off point as soon as possible after their flight. If there are any problems with delivery, the passenger should make contact with the oxygen supplier that will be serving them at their destination.

Problems encountered at the destination

At the patient's destination, there may be a language barrier between the patient and the operatives from the oxygen supplier's assistance phoneline. These operatives will typically speak English and the language or languages of the country that their organisation operates in. If there is a language barrier and the patient has a technical problem with their device, they will be able to contact their home oxygen supplier for advice.

However, if the query pertains to something specific to the destination oxygen supplier (*e.g.* problems with delivery) this can present a problem. It is advised that the individual has access to a mobile device to be able to email the destination supplier so that online translation services can be used to facilitate communication. It is also helpful for the individual to ask their destination supplier about the languages that the assistance phoneline operatives can communicate in prior to travel.

| Table 1 | Overview of | ^r recommena | lations for | <i>patients</i> |
|---------|-------------|------------------------|-------------|-----------------|
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| Stage | Recommendation | | | |
|---------------------|--|--|--|--|
| Planning air travel | Start to plan as far in advance of travel as possible | | | |
| | Discuss other travel-related concerns with your doctor at an early stage (including medical insurance, other medications, oxygen therapy at destination, vaccinations, <i>etc</i> .) | | | |
| | Research airlines to understand different travel policies and restrictions; use ELF's Airline Index to help you [13] | | | |
| | Arrange a fit-to-fly assessment | | | |
| | Ask the airline what information is required on the medical certificate and arrange for this to be produced | | | |
| | When booking flights, choose an aisle seat that is close to the airplane door and toilets | | | |
| | Share the travel itinerary with the oxygen provider | | | |
| | Arrange oxygen supply for travel and at the destination | | | |
| | Contact airport assistance services to plan travel through airports and avoid fatigue | | | |
| At the airport | Take print outs of relevant paperwork with you, including medical certificate copies and instructions and warranty for oxygen equipment | | | |
| | Use assistance services | | | |
| | Make yourself known to airline employees at the gate, and ask to board first or last to avoid having to rush or queue | | | |
| During the flight | Try to relax as much as possible once on the plane | | | |
| | Keep the oxygen equipment instructions accessible in case they are needed | | | |
| | Remind the flight attendant about disembarking first or last | | | |
| At the destination | Use airport assistance services at the destination airport | | | |
| | Make your way to the pre-arranged drop-off point for the destination oxygen equipment as soon as possible | | | |

Summary

For people who require medical oxygen, air travel can be a challenge. However, it is possible if planned carefully and in enough time. Table 1 gives an overview of recommendations discussed in this paper. Doctors, oxygen suppliers and patients should proactively communicate with each other throughout the process. Although airlines have a responsibility under European Commission Regulations to provide equal access to passengers who require medical oxygen to fly, in reality barriers to air travel remain, many of which could be lessened by standardised procedures and requirements.

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Conflict of interest

R. Orritt is an employee of the European Lung Foundation. P. Powell is an employee of the European Lung Foundation. I. Saraiva is Chair of the European lung Foundation.

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Suggested answers

- The level of ambient oxygen in an aircraft travelling at altitude is significantly lower than at sea level.
- 2. POC, use of airline oxygen cannisters, use of "hold" oxygen on aircraft, bringing their own oxygen cannisters (the latter is very rarely permitted).
- 3. For infants, prematurity. For children and infants, a specialist respiratory paediatrician should be consulted.
- 4. They should call their home oxygen supplier's assistance phoneline.

Further reading

EIGA. Document 141/13 Planning Oxygen Supplies for Respiratory Patients when Travelling. www.eiga.eu/publications/ eiga-documents/doc-14113-planning-oxygen-supplies-for-respiratory-patients-when-travelling/

A guide to organising medical oxygen supply for patients while travelling away from their home, and guidance that can be given to the patient about the safe use of medical oxygen on public transport and in public spaces.

European Lung Foundation. Air travel when you have a lung condition. www.europeanlung.org/assets/files/en/publications/ air-travel-web.pdf

Information written in clear accessible language for people with a lung condition who are planning to travel. ELF factsheets are reviewed by patients and topic experts who are members of the European Respiratory Society.

Ergan B, Akgun M, Pacilli AMG, et al. Should I stay or should I go? COPD and air travel. Eur Respir Rev 2018; 27: 180030.

A recent review that evaluates potential risks of air travel for people with COPD and provides insight into planning safe air travel for these patients.