Pulmonary rehabilitation in chronic respiratory insufficiency · 6

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Travel for technology-dependent patients with respiratory disease

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Before becoming disabled by lung disease most patients have lived a normal family, social, and professional life. While the disease progresses slowly the patient manages a "normal life" characterised by the slower pace of daily activities, the material constraints of medical treatment, the precautions necessary to cope with transportation, the practical need to rearrange living space, and the ever present signs of the disease – namely cough, expectoration, and dyspnoea on minimal physical exertion.[1]

Once patients become dependent on oxygen their lives change dramatically. The tubing links them to their oxygen source and symbolises the end of independence and the fulfilling of interpersonal relations. Travelling under such conditions seems completely unthinkable, primarily because of the technical difficulties involved. Nevertheless people with a respiratory handicap are still capable of travelling, providing they receive the necessary encouragement and advice.

Active participation in a pulmonary rehabilitation programme can enable patients to gradually regain self-confidence, merge their equipment with daily life, and improve their physical condition.[2] In 1985 Burns[3] initiated a Caribbean cruise for oxygen-dependent respiratory patients and, since 1986, Belgium's "Association des Insuffisants Respiratoires" (AIR) has organised 20 medically supervised trips to various international destinations for more than 500 patients with chronic obstructive pulmonary disease (COPD), including some 30 oxygen-dependent individuals.[4] Their mean forced expiratory volume in one second (FEV_1) was one litre, with one third of the patients having a value between 500 ml and one litre.

Car travel

Providing adequate oxygen to a patient who is travelling by car will depend on the type of oxygen source the patient is using at home, the number of hours of oxygen required, and the length of the stay away from home. The situation is quite different in patients receiving continuous oxygen from those having oxygen only at night. If the patient is on a concentrator 24 hours a day he or she is very unlikely to undertake travel. If, however, oxygen is required at night only – that is, 15 hours a day, it is practical to take the oxygen concentrator along and to plug it in wherever the patient stays (remembering international voltage differences).

So-called "portable" concentrators can be plugged into the car battery, thereby enabling oxygen to be administered while travelling. Unfortunately portable concentrators have a very limited ability (one or two hours of oxygen) and the commercial distribution network is still rudimentary in Europe. While pressurised oxygen cylinders are no longer used for long term oxygen therapy, they may prove useful for travel. Small 400 litre cylinders will provide 2–3 hours of oxygen at a flow rate of 2 l/min, and 1000 litre cylinders, which are normally easy to transport by car, provide eight hours supply. It is also perfectly feasible to use an oxygen concentrator at night and cylinders during the car journey, providing the patient is not dependent on oxygen for 24 hours a day and can walk without oxygen.

In theory, liquid oxygen is the only form of oxygen that truly frees the patient to move about, given the 7–8 hour supply contained in the portable reservoirs. Beyond this time span the patient must return to the oxygen source to "fill up" the portable system. If the patient is away from the liquid source for more than 7–8 hours an "economiser" nasal device can be used to increase the period of autonomy by some 40%.

Transporting liquid oxygen tanks by car is possible but the tank must be either tightly strapped to the back seat or, preferably, carried in the boot (trunk) of the car. A smaller tank is available that will fit more easily into the boot. A wooden frame should be used to immobilise the tank in the boot. Given the steady evaporation of the oxygen, the boot must be well ventilated by fitting an escape vent to allow the oxygen to escape. If the tank is placed in the passenger area, one window should be open to prevent a build up of oxygen.

Air travel

Today, flying is accessible to almost everyone. It has been estimated that 5% of commercial airline passengers have some disease or illness including chronic obstructive pulmonary disease.[5] Furthermore, a growing number of patients on long term oxygen therapy are now flying. This raises special problems because of the hypoxaemia associated with high altitude flying.

The main American carriers take 8–12 oxygen-dependent passengers on their flights weekly.[6] In Europe SAS carry 500–600 passengers each year who require inflight oxygen. Iberian Airways carried 120 passengers who required oxygen in 1991, and Swissair supplied oxygen to 129 passengers in the last six months of 1992. Aer Lingus estimates the number of oxygen-dependent passengers on its flights to be 70–80 a year, and KLM quote the same order of magnitude (84 patients in 1991). Lufthansa carried 151 oxygen-dependent passengers in 1991, Finnair said it had had only a handful of oxygen-dependent passengers over the past year, and Sabena provides supplementary oxygen at least three times a week (between 150 and 200 passengers per year).

PHYSIOLOGICAL CONSIDERATIONS

Aircraft usually fly at altitudes of up to 12 500 metres (41 000 feet). All commercial airliners are pressurised so that the cabin pressure is higher than the outside atmospheric pressure.[7] Most of the time the cabin is kept at a pressure equivalent to that at 1600–2500 metres (5000–8000 feet) above sea level (table).

International aviation regulations recommend that aircraft flying at their maximum authorised altitudes should keep the cabin pressure equal to that at 8000 feet or 2438 metres.[8] At a cabin pressure equivalent to the atmospheric pressure at 2500 metres the partial oxygen pressure (Pa_{O_2}) of a normal, healthy passenger will drop to 65–68 mm Hg,[9] which still lies on the horizontal part of the oxyhaemoglobin dissociation curve, and saturation will drop 3–4%. In contrast, significant hypoxaemia and desaturation may develop in patients with chronic lung disease[10–12] as they often start with an ambient Pa_{O_2} near to the end of the horizontal part of the oxygen dissociation curve.

While firm data are scanty, medical aid was required for one in every 100 000 passengers (one in 1900 flights) on one American carrier, and 10% of these cases were for a respiratory disorder. The global inflight death rate was one per 6 400 000 passengers between 1976 and 1979.[13] Later statistics covering the period from 1977 to 1984 give an inflight mortality rate of 0·31 per million passengers, with respiratory ailments accounting for only 6% of the total number of deaths.[14]

According to studies on the use of long term domiciliary oxygen,[15 16] oxygen therapy should be administered to patients with COPD who have Pa_{O_2} levels below 55 mm Hg when they fly

Differential pressures and cabin altitudes of different commercial aircraft at a flight altitude of 35 000 feet

Aircraft	*Differential pressure* (psi)*	*Cabin altitude (ft)*
B-727	8·6	5400
B-737	7·45	8000
B-757	8·6	5400
B-767	8·6	5400
B-747	8·9	4700
DC-8	8·77	5000
DC-9	7·76	7300
DC-10	8·6	5400
A-300	8·25	6100
A-320	8·3	6000
L-1011	8·4	5800
BAC-111	7·5	7900
Concorde	10·7	1000

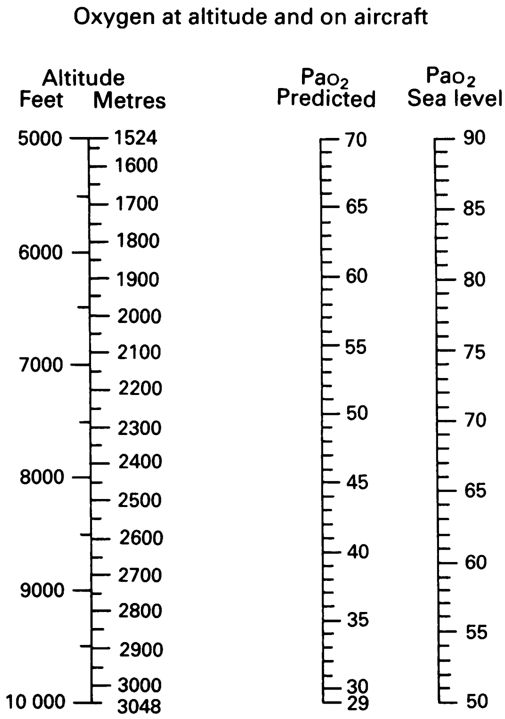
* Pressure differential between cabin and outside air as a result of aircraft compression in pounds per square inch (psi). Modified from reference 21.

at cabin pressures corresponding to altitudes of 5000–7000 feet.[17] Many studies, however, indicate that stable COPD patients may remain asymptomatic and withstand brief altitude-induced hypoxaemia (Pa_{O_2} 30–40 mm Hg) relatively well, even without supplementary oxygen.[17–20] Most of the patients studied were normocapnic rather than hypercapnic and did not have any coexisting cardiac disease. Although the incidence of inflight exacerbations of pulmonary disease seems relatively low, the number of incidents in at-risk passengers that might have been avoided by preventive administration of oxygen is not known.[21]

Nomograms and various equations have been developed to estimate a patient's Pa_{O_2} value during a flight. Gong *et al*[18] developed a formula that uses two variables – the ground Pa_{O_2} value and the altitude in feet – which is valid for altitudes from 5000 to 10 000 feet (1500 to 3000 metres) (figure).

Gong *et al*[18] have also developed a high altitude hypoxia simulation test (HAST) in which the potential passenger breathes a hypoxic mixture of gases corresponding to the altitude at which he will be flying. This enables the amount of oxygen that the patient will require during the flight to maintain an adequate Pa_{O_2} to be determined, as well as the cardiovascular and neuropsychological changes that the hypoxia may induce and the efficacy of supplemental oxygen. This test is particularly useful in the case of patients who are already hypercapnic.

In practice the Pa_{O_2} measured on the ground



Nomogram for predicting altitude Pa_{O_2} (5000 to 10 000 feet) in normocapnic patients with chronic obstructive pulmonary disease at sea level. A straight line connecting sea level Pa_{O_2} and the anticipated altitude will intersect the predicted altitude Pa_{O_2}. The lower 95% confidence limits range between 0·6 and 1·8 mm Hg below the predicted altitude Pa_{O_2} throughout the designated ranges of sea level Pa_{O_2} and altitude. Reprinted with permission from reference 21.

remains the most reliable value for predicting the Pao_2 at high altitudes and thus an inability to withstand altitude.[17 18 22–24] If the preflight Pao_2 is less than 70 mm Hg provision must be made for supplemental oxygen to be available, as the maximum Pao_2 drop at 8000 feet is of the order of 30–35 mm Hg in all pulmonary patients, even in pressurised cabins.[25] Gong[26] thus recommends prescribing inflight oxygen for all patients whose Pao_2 level may drop below 50 mm Hg.

Despite the considerable arterial hypoxaemia at moderate altitudes in these patients, its clinical consequences are still uncertain.[26–28]

PRACTICAL CONSIDERATIONS FOR THE PATIENTS

The request

A request for inflight continuous oxygen during the entire flight must be submitted to the airline's medical department using the INCAD form (standard for all 120 affiliates of the International Air Transport Association) at least 48 hours before departure. This form is provided by the travel agent and must accompany the reservation. The form, filled in by the physician, includes information about the patient's itinerary, flights, specific medical data (diagnosis, prognosis, treatment, clinical state), and the oxygen needs: flow rate and amount of oxygen required. In estimating the oxygen needs one must allow for the flying altitude and possible take-off and landing delays. Adding 60 minutes would be a reasonable safety margin. The patient should always have a copy of his medical form available.

As there are no specific guidelines for inflight oxygen therapy,[29] each airline company has its own regulations. Some companies limit the number of oxygen-dependent passengers they will take on the same flight.[6] In addition, airlines are not obliged to take passengers requiring continuous oxygen.

It is of vital importance to check on the day before the departure that the necessary steps have been taken to ensure that a sufficient amount of oxygen will be available during the flight.[6] Patients should follow up on all arrangements to be sure that their needs are understood by everyone.

Cabin service

While the medical departments of airlines are generally familiar with the problem of oxygen-dependent passengers, the flight attendants usually have only limited knowledge. They sometimes tend to seat such passengers at the back of the cabin in the smoking area! One must insist firmly on a seat in the forward, non-smoking section of the cabin, preferably an aisle seat near the toilets.

In no case may the patient use his own oxygen equipment on board.[30] Portable reservoirs may be brought along empty, either as hand luggage or checked baggage. If the tank is taken along it, too, must be empty. Liquid oxygen is not allowed on aircraft.[31 32]

Airline companies will usually supply oxygen cylinders which are strapped beneath the passenger's seat. While the large 3000 litre cylinders usually have metered valves allowing variable flow from 2 to 8 l/min, the small 300 litre cylinders have fixed flow rates of either 2 or 4 l/min.

The airline companies usually supply facemasks instead of nasal prongs. These masks are rather uncomfortable, especially when they have to be worn for several hours. Patients should take their own prongs with them, as well as tubing. There may be some problems fitting them to the oxygen bottles of the aircraft: a good pair of scissors, a pocket knife, and some extra connectors may be useful.

Ground service at the airport

Airline companies cannot provide oxygen for ground use before boarding, after landing, and at any stopovers. If the patient can do without oxygen while checking in and boarding, there is no problem. For those who are totally dependent on oxygen it may be necessary to use the patient's own portable reservoir during boarding operations until entering the plane, at which point the security staff must take the equipment and return it to the check-in desk where a member of the patient's family can recover it.

If there are stopovers where the patient must get off or change flights, it will be necessary to prearrange (usually through the oxygen distributor) for someone to meet the flight with supplementary oxygen.

Cost of inflight oxygen therapy

Most airline companies charge a supplement for providing inflight oxygen that can range from 40 to 200 US dollars per flight. The service is usually billed for each flight rather than for the litres of oxygen actually used, which is why direct flights are preferable to connecting flights.

General recommendations

The patient must take on board all the medication that is likely to be needed during the flight, especially metered dose aerosols. A battery powered ultrasonic nebuliser may be useful during the flight. These are permitted providing they do not disturb the other passengers and no electrical interference with the plane's communications circuits is possible.[33]

During the flight the patient should avoid overeating and drinking alcoholic beverages; it is important to keep well hydrated because of the relative dryness of the cabin air: the usual temperature is 20–22°C and the relative humidity is low (10–12%), whereas the cabin air is renewed every three minutes.[34]

It is prudent for an oxygen-dependent patient to be accompanied when flying by a companion or spouse who will be able to help if needed.

Cruises

The coastguard regulations regarding transport of liquid oxygen even for medical use are very strict. However, most shipping companies allow oxygen-dependent patients to travel with either their oxygen concentrators or a tank of liquid oxygen. When booking the patient must notify them of the permanent need for oxygen and each company will have to refer the matter to its own medical department, which will require a medical report specifying the diagnosis and oxygen needs.[35 36]

Cruises are particularly suitable for respiratory patients for there are no problems of altitude, pollen, or pollution likely to trigger bronchial spasms.

Travel for patients on mechanical ventilators

There are currently an estimated 8000 patients worldwide using mechanical ventilators at home, a quarter of whom require treatment 24 hours a day.[37]

France and the United States have the most experience in this area. The National Center for Home Mechanical Ventilation in the United States has enrolled over 350 patients to date,[38] and ANTADIR in France[39] monitors 2000 patients on mechanical ventilation.

The most frequent indications for their use are neuromuscular disorders, kyphoscoliosis, sometimes COPD, and sleep apnoea. The most frequently used equipment in Europe is the Monnal-D respirator. Patients are connected to the respirator by a tracheotomy or, more often, a noseclip or facemask. Some of these patients are also oxygen-dependent.

One might assume that only patients who make intermittent use of mechanical ventilation are likely to travel. However, only patients with kyphoscoliosis and sleep apnoea syndromes and COPD enjoy enough autonomy to be able to consider travelling when stabilised.

There is no information available on the number of patients receiving ventilation who travel. Their number will probably increase as more continuous positive airway pressure (CPAP) and BiPAP® systems are prescribed to treat sleep apnoea. Nevertheless, night ventilation remains a cumbersome treatment that the patient already finds difficult to accept at home. Travelling with this equipment will require much energy and courage.

Eurolung Assistance is a network for respiratory patients in Europe and has been in operation for two years. The 1991/92 directory[40] lists not only medical departments directly involved in pulmonary rehabilitation and oxygen therapy, but also medical equipment and oxygen suppliers. The main oxygen distributors have their own international and worldwide distribution network and can supply the oxygen needs to a patient at the intended destination as long as they are active in that location. France has, in addition, a network of home care associations (ANTADIR) that patients can use when they travel.

Some travel companies and associations offer professionally supervised travel opportunities for people with respiratory insufficiency requiring 24 hour oxygen. In Europe the recent association of Wagons-Lits Travel, Vitalaire, the insurance company l'Européenne, and the Association des Insuffisants Respiratoires has made it possible to handle all arrangements needed by these patients. "Life Unlimited" in Florida offers the same service.

When travelling abroad a special travel insurance is mandatory. In case of a road accident the insurance company will take charge of all the costs of the repatriation. In case a sudden unexpected disease is diagnosed, the hospital costs will also be covered. But what about an acute exacerbation of the underlying chronic obstructive pulmonary pathology? Often the condition of travel insurance will not cover any "pre-existing" disease, so a hospital stay for an acute exacerbation during the holiday may not be covered by the insurance. It is therefore very important for the patient to specify any pre-existing chronic pulmonary disease, particularly oxygen-dependent patients who are at greater risk. Not all insurance companies will cover this supplementary risk.

Conclusions

Travelling remains possible for individuals with respiratory handicaps, even for those who are severely limited by the need for constant oxygen therapy, provided certain precautions are taken.

1. Pulmonary rehabilitation: participating in such a programme enables the patient to learn more about the illness and thus cope with it and manage it better. Respiratory reeducation and physical retraining improve the patient's physical condition. A patient should go on vacation only if "stable" and feeling reasonably well.
2. Strict planning: a trip for an oxygen-dependent person cannot be improvised. It must be prepared well in advance. This includes choosing the location, time of year, climate, means of transportation, travelling companion, and taking steps to ensure the continuation of medical treatment, medical resources on site, and oxygen supplies. Taking part in a group trip with medical supervision specially designed for patients with COPD might be a good start.
3. Think ahead: nothing should be left to chance during the trip. The maximum number of difficulties that may crop up should be foreseen and planned for.

The time when the COPD patient's world stopped at the end of the 15 metre tubing that bound him to his oxygen concentrator is a thing of the past. The world is now within reach of the oxygen-dependent person. If the physician can convince the patient to try at least one trip to an unfamiliar destination he may well want to travel again and again.

Appendix

Further information, guidelines, and practical advice regarding travel by patients with pulmonary disease are available from the following sources.

Eurolung Assistance (F Smeets)
Centre Hospitalier Ste Ode,
6680 Ste Ode, Belgium.
Tel: 32-84 45 54 44.
Fax: 32-84 45 54 56.

Mary Burns,
Little Company of Mary Hospital,
Torrance, Boulevard 4101,
Torrance, CA 90503, USA.
Tel: 213 540 7676.
Fax: 213 540 8408.

The Society for the Advancement of Travel for the Handicapped
347 Fifth Avenue, Suite 610,
New York, NY 10016, USA.
Tel: 212 447 7284.
Fax: 212 725 8253.

The Royal Association for Disability and Rehabilitation (RADAR)
25 Mortimer Street,
London W1N 8AB, UK.
Tel: 071 637 5400.
Fax: 071 637 1827.

International Air Transport Association
2000 Peel Street,
Montreal, Quebec,
Canada H3A 2R4.

Life Unlimited
Robbins, Associates Health Care Travel Consultants,
1701 SW 200th Street, Z-28,
Miami, Florida 33187, USA.
Tel: 305 441 6819.

Association des Insuffisants Respiratoires (AIR)
56 rue de la Concorde,
1050 Bruxelles, Belgium.
Tel: 32 2 512 29 36.
Fax: 32 2 512 32 73.

Vitalaire
Dr Haran, 75 Quai d'Orsay,
75321 Paris, Cédex 07, France.
Tel: 33 1 40 62 53 74.
Fax: 33 1 45 55 68 06.

Wagons-Lits Travel
Mr Van Den Bossche B,
Boulevard Clovis 51–53,
1040 Bruxelles, Belgium.
Tel: 32 2 287 88 66.
Fax: 32 2 287 88 73.

L'Européenne Insurance
Mr Demaerschalk,
Rue des Deux Eglises 14,
1040 Bruxelles, Belgium.
Tel: 32 2 220 32 11.
Fax: 32 2 218 77 62.

ANTADIR
Boulevard Saint-Michel 66,
75006 Paris, France.
Tel: 33 1 46 33 02 40.
Fax: 33 1 46 33 74 59.

1 Pretet S, Pignier D, Thomas V. *Comment vivre avec un handicapé respiratoire?* Paris: J Lyon, 1992.
2 Donner CF, Howard P. Pulmonary rehabilitation in chronic obstructive pulmonary disease (COPD) with recommendations for its use. *Eur Respir J* 1992;**5**:266–75.
3 Burns M. Cruising with COPD. *Am J Nurs* 1987;**87**:479–82.
4 Smeets F. Social life organization for severely disabled respiratory patients. In: *Second International Conference on Advances in Pulmonary Rehabilitation and management of chronic respiratory failure, Venice 1992.* New York: Raven Press, 1993: (in press).
5 Iglesias R, Cortes MDCG, Almanza C. Facing air passengers' medical problems while on board. *Aerospace Med* 1974;**45**:204–6.
6 Gong H Jr. Oxygen at altitude and on aircraft. In: Tiep BL, ed. *Portable oxygen therapy: including oxygen conserving methodology.* Mount Kisco, New York: Futura, 1994.
7 McFarland RA. Human factors in relationship to the development of pressurized cabin. *Aerospace Med* 1971;**42**:1303–18.
8 Code of Federal Regulations. Title 14, part 25.841. Washington: US Government Printing Office, 1986.
9 Cardiovascular committee of the cystic fibrosis foundation. Airline travel for children with chronic pulmonary disease. *Pediatrics* 1976;**57**:408–10.
10 Henry JN, Krenis LF, Cutting RT. Hypoxemia during aeromedical evaluation. *Surg Gynecol Obstet* 1973;**136**:49–53.
11 Air travel for chronic bronchitics. *Lancet* 1984;ii:792–3.
12 Cottrell JJ. Altitude exposures during aircraft flight flying higher. *Chest* 1988;**92**:81–4.
13 AMA Commission on Emergency Medical Services. Medical aspects of transportation aboard commercial aircraft. *JAMA* 1982;**247**:1007–11.
14 Cummins RO, Chapman PJC, Chamberlain DA, *et al.* Inflight deaths during commercial air travel. How big is the problem? *JAMA* 1988;**259**:1983–8.
15 Nocturnal oxygen therapy trial group. Continuous or nocturnal oxygen therapy in hypoxemia chronic obstructive lung disease. *Ann Intern Med* 1980;**93**:391–8.
16 Medical Research Council Working Party. Long-term domiciliary oxygen therapy in chronic cor pulmonale complicating chronic bronchitis and emphysema. *Lancet* 1981;i:681–5.
17 Schwartz JS, Bencowitz HZ, Moser KM. Air travel hypoxemia with chronic obstructive pulmonary disease. *Ann Intern Med* 1984;**100**:473–7.
18 Gong H Jr, Tashkin DP, Lee YE, Simmons MS. Hypoxia altitude stimulation test (HAST): evaluation of patients with chronic airway obstruction (abstract). *Am Rev Respir Dis* 1983;**127**:86.
19 Graham WGB, Houston CS. Short-term adaptation to moderate altitude: patients with chronic obstructive pulmonary disease. *JAMA* 1978;**240**:1491–4.
20 Tomashefski JF, Shillito FH, Billings CE, Ashe WF. Effects of moderate altitude on patients with pulmonary and cardiac impairment. *Calif Med* 1964;**101**:358–62.
21 Gong H Jr. Air travel and oxygen therapy in cardiopulmonary patients. *Chest* 1992;**101**:1104–13.
22 Dillard TA, Berg BW, Rajagopal KR, Dooley JW, Mehm WJ. Hypoxemia during air travel in patients with chronic obstructive pulmonary disease. *Ann Intern Med* 1989;**111**:362–7.
23 Bjorkman BA, Selecky PA. High-altitude simulation at rest and exercise to determine oxygen therapy needs in hypoxemia patients during airplane travel: a community hospital experience (abstract). *Chest* 1988;**94**(Suppl):315.
24 Mathur PN, Dowdeswell IRG, Stonehill RB. A method to assess and prescribe controlled oxygen therapy during commercial air travel. *Am Rev Respir Dis* 1984;**129**(Part 2):A51.
25 California Thoracic Society. *Airplane travel information for physicians.* Oakland, California: American Lung Association of California, 1983.
26 Gong H Jr. Air travel and patients with chronic obstructive pulmonary disease (editorial). *Ann Intern Med* 1984;**100**:595–7.
27 Shillito FH, Tomashefski JF, Ashe WF. The exposure of ambulatory patients to moderate altitudes. *Aerospace Med* 1963;**34**:850–7.
28 Richards PR. The effects of air travel on passengers with cardiovascular and respiratory diseases. *Practitioner* 1973;**210**:232–41.
29 Gong H Jr. Advising pulmonary patients about commercial air travel. *J Respir Dis* 1990;**11**:484–99.
30 Federal Aviation Regulation. Part 121.574. Oxygen for medical use by passengers. Oklahoma City: Federal Aviation Administration.
31 Dangerous Goods Board Committee, International Air Transport Association (IATA). Provisions for dangerous goods carried by passengers or crews. In: *Dangerous goods regulations.* Montreal: IATA, 1990:I:1.7.2(B)3.
32 Council of International Civil Aviation Organization (ICAO). Provisions for dangerous goods carried by passengers or crews. In: *Technical instructions for sage transportation of dangerous goods by air.* Montreal: ICAO, 1989/90:I:2.4.2.C.
33 Poundstone W. Air travel and supplemental oxygen: friendly skies for respiratory patients? *Respir Ther* 1983;**136**:79–82.
34 *International Air Transport Association Medical Manual.* Montreal: International Air Transport Association, 1986.
35 Santoro K. A vacation cruise for COPD patients. *Respir Ther* 1985;**15**:31–5.
36 Olenik PC. Planning a cruise? Know the facts about oxygen transport and use. *AARC Times* 1988;**12**:24–9.
37 Howard P. Home respiratory care. *Eur Respir Rev* 1992;**1**:563–8.
38 Make B. National Center for Home Mechanical Ventilation (personal communication).
39 Muir J-F. Home mechanical ventilation in patients with chronic obstructive pulmonary disease. *Eur Respir Rev* 1991;**1**:550–62.
40 Smeets F. Eurolung Assistance Directory. *Eur Respir J* 1991;**4**(Suppl 14):562S.