How to treat

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Flying and health

Background

ABOUT two billion passengers a year now fly on civilian aircraft. Air travel exposes passengers, air crew and pilots to a range of unique physiological stresses and health risks, particularly when they have pre-existing medical conditions.

While long-distance air travel is now cheaper than ever, the risks are greater because journeys are longer, more people are travelling, and more frequently, and there are large numbers of elderly passengers who often have complex medical problems.

The new Airbus A380 promises cheaper long-haul flights at the same speed as the original long-haul Boeing introduced more than 40 years ago, but with the ability to cover almost twice the distance with no stopovers. The A380 has a maximum range of 15,000km, sufficient to fly non-stop from Sydney to Chicago.

The GP has an important role in minimising the health risks associated with air travel through pre-flight screening for medical fitness to fly, advice on risk reduction for long-haul travel and managing post-flight medical conditions, including jet lag and DVT. Depending on the airline and destination, pre-flight travel clearance will be required for patients with certain medical conditions, such as myocardial infarction or acute psychosis.

Travel vaccinations, first aid kits, bird flu kits and adequate medical supplies with associated official medical documentation to support the need for medication are important additional considerations.

In-flight physiological changes include (to name just a few):

- Lowered partial pressure of oxygen (altitude hypoxia).
- Dry cabin air (relative humidity ranging from 10% to 20%).
- Exposure to noise and vibration.
- Motion sickness.
- Dry skin and dry eyes.

‘Aerotoxic syndrome’ now graces the headlines of magazines and refers to fumes from toxic fuel contaminants leaking into cabin air supply through air circulation driven by the plane’s engines.

An explanation of the various factors that can affect the health and wellbeing of air travellers follows.
Aviation physiology

The main physiological changes with ascent to altitude relate to the effect of reduced barometric pressure on oxygen tension (or partial pressure of alveolar oxygen), and to gas expansion in confined spaces, which correlates clinically with various forms of barotrauma.

The relationship between the amount of oxygen in the alveoli at altitude and the severity of hypoxia resulting is complex and subject to a range of variables.

Cabin air pressure

Figure 1 shows that a significant drop in percentage haemoglobin saturation occurs after 10,000 feet, when the sharp descent on the sigmoid curve begins. This phenomenon explains the general effects of high altitude (table 1) and the need for cabin pressurisation.

From figure 1 and table 1 we can see that maintaining a cabin pressure equivalent to that at 6000-8000 feet (1800-2400 meters) above sea level should be tolerated by most passengers, and this is the cabin pressure maintained in aircraft with typical cruising altitudes in the range of 36,000-40,000 feet (11,000-12,200 meters).

Pilots with certain medical conditions (see Medical contraindications to air travel, page 29), in particular cardiovascular and respiratory disease and bleeding disorders such as anaemia, are at the greatest risk for in-flight decompression. Such passengers are usually able to travel safely if arrangements are made with the airline for provision of an additional oxygen supply during the flight.

Barotrauma

An additional well-recognised effect of ascent to altitude is barotrauma (table 2, page 28). Barotrauma may result from natural gas expansion in areas of the body that contain air, such as the middle ear, sinuses, lungs and gut.

Iatrogenic barotrauma may occur when air has been introduced by medical procedures, for example, after any form of laparoscopic surgery, open abdominal or chest surgery, eye surgery or occasionally in pathological conditions, such as rupture of an emphysematous bowel.

Care must be taken not to use air to inflate an endotracheal tube cuff when transferring a patient by air. Normal saline should be used instead.

The likelihood of barotrauma is related to:

- The volume of endotracheal tube cuff when transferring a patient by air.
- The time of transport.
- The duration of ventilation.
- The time of inflation, deflation and placement of a nasopharyngeal/ oropharyngeal airway.

Care must be taken not to use air to inflate an endotracheal tube cuff when transferring a patient by air.

Normal saline should be used instead.

Valsalva manoeuvre (a short forceful expiration against a pinched nose), or check for normal movement of the drum using air insufflation (see Figure 2).

If all else fails the Toynbee manoeuvre by watching the Adam’s apple elevates.

<table>
<thead>
<tr>
<th>Altitude (feet)</th>
<th>10,000</th>
<th>15,000</th>
<th>20,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>% HbO₂ sat</td>
<td>92</td>
<td>89</td>
<td>80</td>
</tr>
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</table>

Table 1: General effects of hypoxia at different altitudes

Care must be taken not to use air to inflate an endotracheal tube cuff when transferring a patient by air.

Normal saline should be used instead.

Valsalva manoeuvre (a short forceful expiration against a pinched nose), or check for normal movement of the drum using air insufflation (see Author’s case study — severe otic barotrauma).

The patient was adamant she needed to return home on the ‘red’ eye that night. She was advised against this and the clinical findings and advice not to fly were clearly documented in the medical record. Unfortunately she did return home and experienced severe otic barotrauma in flight, with severe dizziness on landing and for several weeks afterwards.

The bottom line is that if you cannot easily equalise middle-ear pressure on the ground (the pop or click in the middle ear when you swallow) you should not fly.

<table>
<thead>
<tr>
<th>Altitude (ft)</th>
<th>10,000</th>
<th>15,000</th>
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</thead>
<tbody>
<tr>
<td>% HbO₂ sat</td>
<td>99</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>Symptoms</td>
<td>Decrease in night vision, decreased ability to perform complex new tasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drowsiness, poor judgment, headache, reduced work capacity, poor co-ordination</td>
<td></td>
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</tr>
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</table>
|              | Loss of self-criticism, decreased skill levels, impaired vision, loss of peripheral vision, decreased colour perception, poor co-ordination, bad handwriting, decreased short-term memory, marked changes in emotional state (apathy, bewildergence, moroseness).
|              | Also, symptoms due to hypercapnia, such as lightheadedness, paresthesiae and tetany |

Figure 1: Effect of altitude on the oxygen-haemoglobin dissociation curve.

Figure 2: Round-window fistula. An opening in the round window allows perilymph to leak out into the middle ear which causes dizziness. In this artist’s depiction, for clarity, bone is not shown between the middle ear and fistula. While it is difficult to be sure, it seems likely that in most cases there is only a small oozing of fluid from the perilymphatic space and the air-filled middle ear. Reproduced with permission from Northwestern University, Chicago, US.
from previous page

- After diving that requires decompression stops (‘decompression dive’). Passengers undertaking recreational diving before flying should seek specialist advice from a certified diving school or a hyperbaric medicine unit before flying. If the scuba diver develops any symptoms of the bends, the following numbers are helpful:
  - For emergency help within Australia, toll free 1800 088 200.
  - Australia from overseas (taster pages): +61 8 8212 9242.

Altitude decompression sickness

This has been described in pilots and occurs in unpressurised aircraft. It may also be seen in altitude ‘chamber runs’ (being in a pressurised chamber where the atmosphere is removed by compression and the internal pressure drops) after acute flying or in air force pilots. Symptoms frequently resolve on descent.

Cabin humidity and dehydration

It is well known that long-haul flying is associated with an array of symptoms arising from low cabin humidity, which usually ranges from 10% to 20%. Low humidity may cause skin dryness and discomfort of the eyes, mouth, nose and exposed skin but presents no risk to health. Using a skin moisturising lotion, a saline nasal spray to moisturise the nasal passages and wearing spectacles rather than contact lenses can relieve or prevent discomfort.

Cabin fever (aerotoxic syndrome)

The occurrence of a variety of symptoms in pilots, air crew and passengers has stimulated the investigation of cabin air quality. The basis for the hypothesis is that cabin air is routinely drawn off engines and supplied to aircraft cabins (not so in the new Airbus A380). If seals within the engine compartment are not secure, engine oil can leak and the products of this pyrolysis can leak into the cabin air supply. These products include (tricom)phosphate, the tri-ortho isomer of which is an organophosphate cholinesterase inhibitor capable of inducing a delayed neurological effect.

Typical symptoms reported include headaches, nausea, metallic taste in the mouth, tight chest, dry stinging eyes, dizziness, blurred vision, difficulty concentrating and temporary paralysis (which has been reported in pilots). Longer-term reported symptoms include memory loss, chronic fatigue, and neurological and respiratory problems.

Current terminology appearing in recent literature refers to ‘aerotoxic syndrome’. There is no single symptom or set of symptoms that characterises aerotoxic syndrome. Odours described as “dusty socks” or “musty” may or may not be present and it is unknown how altitude hypoxia affects the toxicity of oil pyrolysis products.

If you suspect you may have a patient with aerotoxic syndrome you would be well advised to seek advice from an aviation toxicologist or aviation-trained doctor.

Communicable diseases

HSN1 avian influenza, SARS, multi-drug-resistant tuberculosis and polio have all been transmitted in-flight. The adage of recommending to your patients not to attend work when they are actively infectious applies even more so when they are planning air travel.

Any passenger with a potentially infectious illness must not board an aircraft and must seek clearance to fly from the airline. Airlines may deny boarding to passengers who appear to be infected with a communicable disease.

The quality of aircraft cabin air is carefully controlled. Ventilation rates provide a total change of air 20-30 times an hour. Most modern aircraft have recirculation systems, which recycle up to 50% of cabin air usually through high-efficiency particulate air (HEPA) filters, of which the type used in hospital operating theatres and ICUs, which trap particles, bacteria, fungi and viruses.

While the overall risk of transmission is exceedingly low in terms of kilometres travelled versus the risk of developing a transmissible disease, the following measures can help:

- Wash hands thoroughly with alcohol wipes before eating or touching the face.
- When possible, keep social distance to >1 metre. Transmission is still possible via fomites on common surfaces touched by the infected person and other passengers.
- Use a P2 or N95 mask if a passenger nearby seems infectious. Face masks are available in many different styles, offering different levels of protection. The most common and most economical face mask is the standard surgical mask.

A good-quality surgical mask should be three-ply, having an inner hydrophilic layer (worn closest to the skin and absorbing moisture), a middle filter layer and an outer hydrophobic layer. While a standard surgical mask does not have to be tested for its efficiency in filtering out particles to meet Australian and international standards, it must be able to filter bacteria to a level of 95% at 3.0 microns. The N95 particulate respirator mask is able to filter out 95% of oil-free microscopical particles, down to 0.3 microns in size (the ‘N’ stands for ‘Not oil proof!’). This is an American standard; the Australian equivalent is known as P2 (‘P’ for ‘particulate’). These masks are very lightweight and easily carried and are available from some pharmacies or medical suppliers.

- Comprehensive HSN1 (bird flu) kits suitable for home, work or travel are commercially available and generally include gloves, gowns, proper HSN1 face masks, such as a P2 or N95 respiratory mask, alcohol swabs, avian flu pocket advice sheet and a toll-free contact number or web site references.

Author’s case study — blurred vision after a long-haul flight

A 25-YEAR-old patient with Eisenmenger’s syndrome (left to right cardiac shunt), with symptoms only on arvalution up stairs (NYHA grade II), requested medical clearance from her GP to fly to attend a work-related conference in Chicago for one week.

Her regular treatment included monthly venesections for control of secondary polycythaemia, hydralazine and aspirin. After discussion with her haematologist, venesection to ensure a haematocrit of 0.52 two days before flight was arranged and she wore anti-embolism stockings throughout the flight. Twenty-four hours after arrival in Chicago the patient developed blurred vision in one eye and was found to have a left central retinal arterial occlusion. She was given warfarin and the return journey was altered to include multiple stops with no flight exceeding six hours.

There was a permanent minor residual central visual field defect. Dehydration was thought to be the most significant modifiable contributing factor to this presentation.

Comment

This case highlights some of the complexity involved in assessing medical fitness to fly and that airlines or aviation authorities do not record or report the vast majority of post-flight complications or deaths that pertain to air travel.

The most likely cause was paradoxical embolism through the cardiac shunt while straining, contributed to by dehiscence and prolonged immobility. The patient acknowledged sleeping for most of the flight and not drinking fluids soon after arrival in Chicago.

The question of suitability and fitness to fly was discussed with the patient’s cardiologist and haematologist. Approval was given subject to venesection before travel.

Questions posed by this case include:
- Should this individual not have flown long haul at all?
- Should the forward journey have been reduced to smaller segments of six-hour flights, with associated extra costs?
- Would substitutive heparin have prevented this event?
- Why did the compression stockings not assist? Were they incorrectly sized?
- Can future long-haul travel be contemplated and, if so, which parameters apply?
- There are no correct answers!
Flights with 1-2-week stays are which may take 2-7 days or usually disappear as the body combined with tiredness due to the conditions that prevent travel or risks. Table 3 summarises common medical contraindications to air travel. Each airline has MEDICAL contraindications may be absolute (eg, pneumothorax) or relative (eg, pregnancy). Every airline has its own set of standards and it is essential that any doctor or passenger liaise with the airline if unsure of the risks. Table 3 summarises common conditions that prevent travel or require a medical clearance to fly. (See Online resources for more details, page 30)

**In-flight emergencies**

There is about one medical event for every 11,000-50,000 passengers, or about 30 such events a day on a global basis.

True medical emergencies are rare and most in-flight medical incidents are due to minor conditions such as musculoskeletal injuries, GI upset, dehydration or leaving essential medication in stowed luggage. Serious emergencies are rare, with cardiopulmonary resuscitation being required rarely (incidence rate of one emergency per 20,000 passengers).

The most common significant problem is fainting and/or dizziness. Other relatively common events are asthma, allergies (especially to peanuts), head trauma (usually as a result of objects falling from overhead lockers and sometimes from turbulence), anxiety and panic attacks, chest pain and heart attacks. Births have been recorded in flight. It has been shown that a doctor is travelling on board an aircraft as a passenger in 85% of cases. In several studies the rate of on-board doctor participation in in-flight medical events has variously reported at anywhere from 8% to 3% of cases. Aircraft diversion is a complex issue and the captain has the ultimate decision. It may take 30-45 minutes to prepare for a diversion and cost up to $US100,000-200,000 (£) (about £113,300-227,000) depending on the situation.

**Medical kits**

Airlines are required to provide basic levels of medical equipment on aircraft and to have cabin crew trained in first aid. The equipment carried varies, with many airlines carrying more than the minimum level of equipment required by the regulations. Equipment carried on a typical international flight includes:

- One or more first-aid kits, to be used by the crew.
- A medical kit, normally to be used by a doctor or other qualified person to treat in-flight medical emergencies. This will usually have a stethoscope, adrenaline, lignocaine, glucose, a glucometer and nitroglycerine spray.
- An automated external defibrillator (AED) to be used by the crew.
- A patient disembark (known as ‘anchor sleep’), getting exposure to daylight, taking naps at times when up the total sleep time by several hours before departure and rest during the flight. Short naps can be helpful.
- Eating light meals.
- Limiting consumption of alcohol and caffeine. Alcohol increases urine output, which can result in disturbed sleep by promoting the urge to urinate.
- Trying to create the right environmental conditions for sleep. Eye shades and earplugs may help. A minimum block of four hours’ sleep during the local night (known as ‘anchor sleep’), is thought to be necessary to allow the body’s internal clock to adapt to the new time zone. If possible, make up the total sleep time by taking naps at times when feeling sleepy during the day.
- Getting exposure to daylight at the destination, which usually helps adaptation.
- Use of short-acting hypnotics in flight should be discouraged because:
  - They may elevate the risk of DVT by promoting the urge to urinate.
  - The probability of an in-flight mechanical problem requiring the pilot to return to base is highest in the early phase (first two hours) of flight — being assisted from the passenger cabin is a stretcher or in a stuporous state is never appealing. Thus, hypnotics should especially not be used in the first two hours of a long-haul flight.
- Altitude hypoxia and other factors may increase susceptibility to side effects. The aircraft cabin is therefore never the place to first test a hypnotic. If they are to be used it is always better to do a ‘ground test’. Several human trials suggest that melatonin taken by mouth, started on the day of travel (close to the target bedtime at the destination) and continued for several days, reduces the number of days required to establish a normal sleep pattern, diminishes the time it takes to fall asleep (‘sleep latency’), improves alertness and reduces daytime fatigue.

The scientific evidence suggests a slight to modest benefit of melatonin in up to 50% of passengers who take it for jet lag. More trials are needed to confirm these findings and to determine optimal dosing.

Melatonin dosage regimens vary from 0.5mg daily to 5mg, or higher. Higher doses may cause melatonin to become ineffective. Side effects are generally mild and may include headache, dizziness and nausea. Drug interactions with monamine oxidase inhibitors are known to occur.

**Jet lag**

Jet lag is the term used for the symptoms caused by the disruption of the body’s circadian rhythms that occurs when crossing multiple time zones, that is, when flying east to west or west to east.

**Reduced physical and mental performance**

- Difficulty in sleeping at night.
- Reduced physical and mental performance.
- Difficulty in sleeping at night.
- General malaise.
- Fatigue.
- Daytime sleepiness.

There are no known reliable measures to counteract jet lag. Many products are touted to reduce the symptoms but only melatonin has shown any promise in scientific studies, although effects are small and the dosing is complicated (see below).

General measures to reduce the effects of jet lag include:

- Being as well rested as possible before departure and resting during the flight. Short naps can be helpful.
- Eating light meals.
- Limiting consumption of alcohol and caffeine. Alcohol increases urine output, which can result in disturbed sleep by promoting the urge to urinate.
- Trying to create the right environmental conditions for sleep. Eye shades and earplugs may help. A minimum block of four hours’ sleep during the local night (known as ‘anchor sleep’), is thought to be necessary to allow the body’s internal clock to adapt to the new time zone. If possible, make up the total sleep time by taking naps at times when feeling sleepy during the day.
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Medical conditions

Deep vein thrombosis

- Involves clotting of blood in the veins.
- Can lead to pulmonary embolism if clot breaks off and travels to the lungs.
- Risk factors include long-haul travel, immobility, and certain medical conditions.

Treatments

- Anticoagulants: Reduce blood clotting.
- Compression stockings: Prevent formation of new clots.
- Exercise: Help activate blood flow.

Diabetes

- A chronic condition where the body either doesn't produce enough insulin or can't use insulin effectively.
- Common in older adults, those with obesity, and family history.

Management

- Healthy diet and exercise.
- Medications (oral or insulin).
- Regular check-ups and blood tests.

Conclusion

Air travel can pose health risks, but with proper planning and preparation, these can be minimized. The key is to be informed about your health condition and to consult with your healthcare provider before traveling.
GP's contribution

Questions for the author

The is the effect of 'party drugs' likely to be exaggerated in flight?

As you might expect, there have been no studies on this topic. However, given that the behavioural changes of alcohol are well documented in flight (for a routine flight one standard drink has the clinical effects of two on the ground) one would expect that alcohol would have an effect and that administering medical oxygen might assist.

You mentioned that there are medical incidents in flight a day internationally. Is there a significant reporting of events across airlines or are these only the incidents for which the doctor's bag was used?

Each airline has its own procedures for reporting. The International Civil Aviation Organisation (ICAO): www.icao.int sets minimum standards for reporting and has produced the document Air Passenger Health Matters (www.icao.int/icao/en/assemble235wpwpyp122_.pdf) for use by airlines (see page A-9, Part 2).

All incidents should be recorded in the manifest of the aircraft by the chief purser, but as how often are not recorded I do not know. As my own experience I know that some have not been reported.

Are we aware of what training ground staff are given to deal with medically fit to board a plane? All staff go through an induction and training program (about three weeks' duration) set through agreement between the airline and CASA or the local organisation responsible for aviation safety. The quality varies.

The more established airline has a medical department and airline medical officers who assist ground staff. Once again, ICAO have set the minimum standard here.

General questions for the author

From recent personal experience the 'basic medical equipment' that all airlines should carry was somewhat inadequate. For example, only a single pair of very small gloves was supplied, with no sharps container available. The dosing on vials of medication such as adrenaline were not the same as used in Australia. Is there an international agreement on what doses of drugs should be available? Is there a reason that lignocaine vials would be included but not morph-

Aspin is definitely recommended for flights over six hours, and possibly in those of 4-6 hours. If there are other risk factors for DVT, such as smoking, the threshold for recommending aspirin is lowered.

How to treat flying and health

Case study

MISS M, 20, was noted at check-in to be acting strangely and likely to be "under the influence". The cabin crew is advised not to serve her any alcohol. About two hours into a long-haul flight, assistance is sought from a doctor on board, as her behaviour is disruptive. It is obvious to the doctor that it is not alcohol at play but a hallucinogenic substance. The doctor did not use anything in the doctor's bag, no recording of this medical incident is made by the air crew.

1. For which TWO medical scenarios would patients usually need to provide written medical clearance to be able to fly?

a) Anemia with an Hb level of 70g/L
b) Normal neonates aged less than one month
c) Within two weeks of resolution of a pneumonia
d) Exacerbation of asthma in the past two weeks

2. Marwan, 68, has COPD of moderate severity, with breathlessness on walking more than 100m on flat ground. His Hb level is 175g/L and resting oxygen saturation is 92%. He plans to fly to the US to visit family. Which TWO statements about this flight for Marwan are correct?

a) As Marwan does not need supplemental oxygen at home, he will not require this for the flight
b) He plans to visit Denver, Colorado, at an elevation of about 1600m (or 5280 feet) for a few days. As this is less than typical cruising cabin altitude, you have no significant concerns with this visit
c) He is at a moderate risk of DVT on this flight

d) Marwan should be reviewed by his respiratory physician during planning of his trip

3. Bruce, 63, has been holidaying in Malaysia. His daughter tells you he is in hospital, having just had a heart attack. What information can you give his daughter about the restrictions that are likely to be imposed on Bruce’s return to Australia (choose TWO)?

a) It will be at least one month before the air crew would allow him to fly
b) He will not be allowed to fly on his scheduled return flight in five days’ time
c) He will need medical clearance if he wishes to return home before three weeks’ time

d) Even when stable he will need an escort to travel with him on the return journey

4. Ellen, 32, presents twice a day for a trip from Sydney to Brisbane for work. She has had an URI during the past week and just popped in to “have her ears checked for the flight”. She has had no significant ear aural discharge and does not have a feeling of blockage in both ears. Which TWO statements about flying with a middle-ear effusion are correct?

a) There is a risk of permanent sensorineural hearing loss
b) The greatest risk of barotrauma occurs on take-off and climbing to cruising altitude
c) If you can see an air fluid level or air bubbles in the middle ear on otoscopy, this implies that the effusion is clearing and the patient is safe to fly
d) If Ellen’s ear drum cannot be seen to move and she does not easily feel her ear pressure equalising on Valsalva, she should be advised not to fly

5. Which TWO statements about the cabin environment are correct?

a) Humidity of the air is controlled at 50%
b) A total change of cabin air occurs about 10 times an hour
c) The level of cosmic radiation for pilots is about 2-4 times the background exposure for the general population
d) Cabin pressure is such that most healthy people’s Hb oxygen saturation ranges from about 93% to 97%

6. Ahn, 24, is travelling to the UK and comes to ask your advice about minimising the effects of jet lag. Which TWO pieces of advice about reducing jet lag are correct?

a) Ahn should make himself sleep deprived before the flight so that he sleeps better on board
b) He should limit alcohol and caffeine during the flight
c) He should try melatonin, as it is likely to be of benefit in >80% of people
d) Exposure to daylight at the destination will be helpful

7. Which TWO statements about in-flight emergencies are correct?

a) All airlines are required to have some medical equipment on board
b) All airlines have cabin crew trained in first aid
c) Serious medical emergencies during the flight are a frequent event
d) The most common significant medical problem managed in-flight is chest pain

8. Janice, 57, consults you before flying to Scotland for a holiday. She has bilateral lower leg varicose veins. She takes oral HRT for menopausal symptoms. Janice has heard about DVT associated with flying and comes to discuss this with you. Which TWO statements about DVT and flying are correct?

a) Risk of DVT starts to increase with flights longer than six hours’ duration
b) Varicose veins and oral oestrogen therapy are additional risk factors for DVT during a flight
c) Patients such as Janice should be screened for thrombophilia before travel

d) Age >40 is a risk factor for DVT

9. What advice do you give Janice to reduce her risk of DVT (choose THREE)?

a) Wear appropriate compression stockings during the flight
b) She should receive low-molecular-weight heparin before travel
c) She should take low-dose aspirin two hours before take-off and again at 24 hours after

d) Increase fluid intake during flight

10. Bob, 62, has type 2 diabetes. He takes metformin tablets and twice-daily insulin. What advice do you give Bob to help him with managing his diabetes while flying to Italy (choose THREE)?

a) He should keep some of his insulin with him and keep the rest in his stowed luggage
b) He will need a letter from you to allow him to carry needles and insulin vials on board
c) He should arrange with the airline to have diabetic meals
d) He should take his metformin at the usual time, but will need to adjust his insulin dose