CHAPTER 16

Travel with Chronic Medical Conditions

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In addition to travel by rail, ship, and automobile, almost 2 billion people travel by air annually. It is generally expected that primary care providers as well as travel medicine clinic personnel will identify individuals who are unfit for air travel and provide them with advice. Studies show that more than 95% of travelers with health problems who travel by air would like to receive additional medical advice from their providers prior to travel. The age of travelers is ever increasing as the population ages. Currently in the United States 14% of people are over 65 years of age. A recent Swiss study, by Boubaker, et al. 2016, reported that 10% of visits to a travel medicine clinic for pre-travel advice were made by travelers over the age of 60; 40% of these travelers reported a chronic medical condition.

It is important for the elderly traveler or those with chronic medical conditions to consider factors such as access to medical care, the possible increased demands for aerobic exercise, changes in diet, availability of medical supplies, and the effects of altitude when planning a trip to a foreign destination; thus, advance planning is essential for persons in this category of travelers. Another factor that could make a significant difference in the success of a journey is the ability to travel with a companion. The traveling companion need not be medically trained but could provide invaluable help in getting professional assistance should an urgent medical need arise. There are also commercial companies, such as Accessible Journeys, that maintain a directory of healthcare professionals willing to use vacation time from their jobs to accompany a traveler. It is important to advise the traveler to check the professional credentials and references of travel companion programs. A website that features a number of companies and travel agents that can assist with special travel services is www.disabledtravelers.com. Additionally, the US Transportation Security Administration (TSA) has a website that offers helpful information for travelers with medical conditions, as well as a TSA Cares Help Line. They advise that callers call at least 72 hours prior to travel, thus allowing the TSA Customer Service Manager advance notice that a specific traveler may need assistance. This information can be found at www.tsa.gov/traveler-information/travelers-disabilities-and-medical-conditions.

There are many remote areas of the world where medical care may be hours or days away from a traveler stricken by illness or complications of a pre-existing condition. If an elderly individual or one with a chronic disease is very stressed by the thought of remote travel and lack of access to care, it may be justified to counsel that traveler to adjust his or her itinerary to one that includes the availability of adequate medical care. The traveler with chronic medical conditions has to consider whether the anticipated benefits of the planned travel experience are worth the potential health risks associated with a given itinerary. This said, travel can be an extremely rewarding and confidence-building exercise for those limited by a chronic condition. The clinician advising the traveler must take into account the positive impact travel can have on an individual's sense of well-being while being realistic and practical when providing travel advice. The clinician advising the elderly traveler should

recognize that the aging process brings with it changes that necessitate careful planning prior to travel. For example, it is prudent to advise the elderly traveler to get a thorough dental exam prior to embarking on a long trip. More than 50% of people will develop hypertension by the age of 65. Muscles begin to atrophy after the age of 40, and by the age of 80, one has lost between one-quarter and one-half of one's muscle mass. When advising the traveler at the far end of the lifespan on appropriate travel itineraries, their current state of health should be kept in mind; whether the individual has been relatively healthy or an infrequent user of health services, he or she may have underlying issues that could impact health without being aware of these based on the aging process alone. Aging can lead to immunosenescence, which impairs the host's ability to develop adequate immune responses to vaccines. Additionally, for the same reason teeth and bones are at risk due to lack of mineralization. Lack of bone mass, or osteopenia, is a major risk factor for fractures. A fracture on a trip can certainly ruin a trip, prolong disability for many months, and be a lifelong affliction in the elderly. Advise the elderly traveler to have a bone scan and assessment of risk for osteoporosis, and make recommendations based on the study. There is little we can do medically to slow the aging process, so prudent thought should go into the advice one gives elderly travelers, who may not readily want to admit their limitations or, indeed, may not even know they have them. On the other hand, research by Shitrit and Chowers (2010) reveals that because elderly travels tend to comply with health recommendations and are more careful about health-risk behaviors such as eating street food or drinking open drinks while abroad, their risk for illness during travel was significantly lower than that of younger travelers.

The Air Carrier Access Act of 1986 resulted in the US Department of Transportation developing regulations to assure that persons with disabilities and chronic medical conditions are treated without discrimination. However, air travel can be stressful because of noise, turbulence, crowding, limited seating space, and psychological factors (fear of flying, fear of terrorism, etc.). Air travel may present high-altitude barometric and oxygen stresses (Chapter 4), as well as rapidly transport the traveler across many time zones, necessitating special changes in the timing of medications. Travel by land or sea routes may be less stressful for people with medical conditions but still requires advanced planning. Regardless of mode of transportation, if special medical equipment must be taken along (wheelchairs, dialysis equipment and fluids, oversize or excess baggage for supplies, etc.), travelers should contact the medical departments of major airline, railroad, or cruise ship companies for specific information and guidance before confirming reservations. Travelers with mobility issues may have additional concerns as they plan their travel itinerary. The Centers for Disease Control and Prevention recommends that travelers with medical conditions or mobility issues due to age or other factors should seek pre-travel consultation at least 4 weeks before departure (2016, CDC Yellow Book, chapter 8).

Some commonsense approaches to pre-planning for travel with a medical condition will go a long way toward the prevention of problems while en route as well as at one's destination. It is important to advise the traveler to have an updated list of medications and doses as well as an adequate supply of medications to cover the duration of their journey.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE, ASTHMA, AND OTHER RESPIRATORY CONDITIONS

The effects of exercise, exposure to cold, altitude, and extreme heat can be significant stressors for the traveler with underlying lung disease. The presence of environmental allergens and pollution in various cities of the world, such as Delhi, Beijing, Mexico City, and Kathmandu, to name a few, are additional significant considerations.

The Federal Airline Regulations require that airlines maintain a cabin pressure simulating an altitude between 5000 ft (1524 m) (e.g., Denver) and 8000 ft (2438 m) (e.g., Mexico City). Healthy passengers can tolerate this change in altitude, but patients with pulmonary disease may have increased hypoxemia owing not only to diminished oxygen pressure, but also to impaired hypoxic ventilatory drive, decreased cardiac reserve, and mechanical

limitations. A study of adults in a simulation of a 20-hour flight revealed that the frequency of reported complaints associated with acute mountain sickness (fatigue, headache, lightheadedness, and nausea) increased with increasing altitude and duration of flight. This peaked at 7498 ft (2438 m) and became apparent between 3 and 9 hours of exposure (Muhm et al. 2007).

The relatively low humidity inside the passenger cabin (10-12%) may cause difficulty for patients with thick pulmonary secretions or tracheostomies, so adequate individual hydration must be maintained. Water is the best beverage to maintain hydration while in the air or at altitude.

In general, overeating, alcoholic beverages, sedatives, and cigarette smoking should be avoided by patients with respiratory conditions during air travel and once at destination. While smoking on commercial aircraft is illegal, it is important that travelers who are concerned about environmental exposure to tobacco smoke be aware that smoking by others could present a problem in restaurants, hotels, banks, conference rooms, and other public places of business, as well as on buses and other modes of public transportation. The prevalence of smoking among the residents of the areas to be visited and the existence of smoke-free environments may influence the choice of itinerary for this group of travelers. Fortunately, smoking is prohibited in eating establishments and bars in the United Kingdom and Europe, but this does not apply to the many outdoor cafes or seating areas.

Table 16.1 presents some pulmonary contraindications to air travel. However, these contraindications are general, and certain individuals with chronic lung disease who fall into one of these categories may be able to travel on the advice of their medical providers. Most experts recommend supplemental oxygen during air travel for people with a baseline oxygen

TABLE 16.1 Respiratory Contraindications to Air Travel[a]

Conditions adversely affected by hypoxia
Active bronchospasm
Cyanosis
Dyspnea at rest or during exercise
Pneumonia or acute upper respiratory tract infection
Pulmonary hypertension with or without cor pulmonale
Severe anemia (hemoglobin level 7.5 g/dL) or sickling hemoglobinopathies
Unstable coexisting cardiac disorders, such as arrhythmias, angina pectoris, and recent myocardial infarction (within 3-4 weeks)
Conditions adversely affected by pressure changes
Thoracic surgery in the preceding 3 weeks
Noncommunicating lung cysts
Otitis media, sinusitis, or recent middle-ear surgery
Pneumothorax or pneumomediastinum
Inadequate pulmonary function (as evidenced by one or more of the following)
Diffusing capacity <50% of predicted
Hypercapnia ($PaCO_2$ >50 mmHg)
Hypoxemia while breathing room air (PaO_2 >50 mmHg)
Maximum voluntary ventilation less than 40 L/min
Vital capacity <50% of predicted
Other contraindications
Contagious diseases, including active tuberculosis

[a]These contraindications are relative, since patients may significantly improve with appropriate therapy and supplemental oxygen.
From: Gong, H. Jr., 1990. Advising COPD patients about commercial air travel. J. Respir. Dis. 11, 484–499.

TABLE 16.2 Decline in Blood Oxygen Tension with Increase in Altitude in Two Patient Groups

Group	PaO_2 Sea Level	PaO_2 5500 ft	PaO_2 8000 ft[a]
Healthy young adults	98 mmHg	68 mmHg	60-63 mmHg
Patients with COPD	72.4 mmHg	–	47.7 mmHg[b]

[a]A given cruising altitude of 35,000 ft above sea level will result in a cabin altitude varying from 5000 to 8000 ft among different aircraft models, according to pressurization schedules.
[b]After 45 min steady-state hypobaric exposure, equivalent to 8000 ft above sea level.
COPD, Chronic obstructive pulmonary disease.
From: Dillard, T.A., Berg, B.W., Rajagopol, K.R. et al., 1989. Hypoxia during air travel in patients with chronic obstructive pulmonary disease. Ann Intern Med 111, 362–367.

saturation of 95% or less. Several methods and equations are available to assess the need for in-flight oxygen, and some guidelines suggest a hypoxic challenge test in individuals with an oxygen saturation of 92-95%. Predictive equations do not always accurately estimate the need for in-flight oxygen. Sea-level blood gas or pulmonary function testing with a hypoxic challenge remain the gold standard, with oxygen recommended for those with a PaO_2 of 70 mmHg or less or with an in-flight PaO_2 expected at 55 mmHg or less. Guidelines established by the British Thoracic Society in 2002 suggest that in-flight oxygen is not needed if the patient's resting SpO_2 (O_2 saturation) measured with room air is >95% and there are no additional risk factors. If a patient has a resting room air SpO_2 <92% at sea level, he or she will require in-flight oxygen. These studies are ideally performed on a clinically stable subject as close to the travel date as possible. **Table 16.2** shows the drop in the arterial PO_2 going from sea level to an altitude of 8000 ft in healthy young adults and in a group of patients with chronic obstructive pulmonary disease (COPD). Anyone requiring oxygen supplementation on the ground will obviously need it for air travel. British Thoracic Society or Aerospace Medical Association guidelines should be used for patients affected by pulmonary or cardiac disease who desire to travel by air.

Supplemental Oxygen

Passengers who require supplementary oxygen during flight can now bring their own Department of Transportation-approved portable oxygen-concentrating devices on-board most airlines. These must be "approved devices" and currently include a variety of portable oxygen concentrators. Passengers are responsible for making oxygen arrangements with the airplanes. At the time of writing, domestic airlines no longer provide supplemental oxygen, and one must utilize a third party supplier, such as Oxygen to Go, which will facilitate all of the procedures necessary and provide rental units and supplies. A company such as this, which arranges all aspects of the oxygen needs and has been in the business of doing so for more than 10 years, may be an excellent starting place for the traveler requiring supplemental oxygen (www.oxygentogo.com). Most carriers require an advance notice of 48-72 hours, but some can require 10 days to 2 weeks advance notice. Passengers should also consider the need for oxygen use during any layover stop(s) and at their final destination. They must also make arrangements (with the airline, friends, or relatives) with a local supplier for removal of the canister from the originating airport's gate area immediately after the gate is exited to board the aircraft. FAA regulations require that for all passengers requesting supplemental oxygen, airlines must obtain a signed physician's statement (specific to each airline), which must be provided by the traveler at least 48 hours prior to travel. This statement will include information such as the desired flow rate, type of mask, and whether the oxygen is to be used intermittently or continuously. The fees for rental of portable oxygen concentrators and the associated batteries and services can range from US$350 for a short flight and 1-week rental upward to US$1200 depending on the length of the trip. Airlines require that passengers requiring oxygen have 150% additional battery power above that

supplied with the unit. Other respiratory equipment such as mechanical ventilators or nebulizers may be allowed on board, but their use must be pre-approved. These supplies must conform to applicable FAA regulations in order to avoid interference with sensitive aviation electronic equipment. Additional information on airline accommodations for supplemental oxygen can be found at the National Home Oxygen Patient's Association website (www.homeoxygen.org).

Special arrangements have to be made with oxygen distributors at each airport for supplies of oxygen needed on the ground during layovers and airport transfers to connecting flights, and even for the final destination if it is more than 5000 ft above sea level. Passengers should contact a local full-service oxygen supplier that can deliver oxygen not only at the home origin but at the destination and layover city with advance notice of at least 72 hours to ensure delivery. Travelers with moderate to severe COPD who are hypoxic at ambient conditions at home should not plan trips to high altitudes. The risk for high-altitude pulmonary edema is significant in these individuals.

The traveling companion should be instructed that visual impairment, fatigue, headache, sleepiness, dizziness, personality changes, and impaired memory, judgment, and/or coordination may be signs of oxygen deficiency and that medical assistance may be needed.

Travelers with Asthma

In 2007, the National Heart, Lung, and Blood Institute estimated that 22 million people, more than 6 million of them children, have chronic asthma in the United States. Respiratory infections are among the common ailments of travelers, with personal stress, air travel, contact with strangers, and environmental contamination all contributing to the risk of exposure. Thus, it is important for the traveler with asthma and other chronic respiratory conditions to have annual immunization against influenza and to be up-to-date on all other recommended vaccines (including pneumococcal vaccine and pertussis [DTaP]). Travelers over the age of 65 should have the pneumococcal pneumonia vaccine at least 1 month before travel as well as the shingles vaccine.

It is essential the clinician assure that the patient with asthma wishing to travel have stable and well-controlled asthma before embarking on a journey. Travelers with any remote history of asthma or reactive airway disease should be warned that travel to a new place could trigger asthma, even if they have been asymptomatic for years. Molds and pollens may present new or unidentified triggers for exacerbations of asthma. Dust mites and cockroaches are prevalent in some regions of the world, and exposure to byproducts of these could pose increased risks for triggering asthma attacks in hotel rooms and other dwellings. Air pollution is a significant problem in urban areas of the developing world (Chapter 2) and may cause exacerbations of asthma. Patients with asthma traveling to colder environments should be instructed to wear hats with a face mask or scarf to rewarm inhaled air, and appropriate clothing. Unlike patients with COPD, patients with asthma generally do well at altitude. Some theories for this are that they are less exposed to allergens and other etiologic factors responsible for triggering asthma exacerbations. In addition, patients with asthma may be more sensitive to declines in their respiratory function and may spontaneously limit or decrease their activity levels as this occurs. This may have a protective effect when trekking to altitude and while engaging in other types of physical activities.

Travelers with asthma should hand-carry an adequate supply of medications. Medications should not be placed in checked baggage during travel. All medications should be transported in their original containers, showing medication name, dose, dosing schedule, pharmacy, and prescribing physician. Asthma is a problem worldwide, and while it is best for patients to use medications acquired at home, traveling patients should be informed in case of lost or missing supplies that certain common medications may be available abroad under different brand names but similar formulation. For example, albuterol may be available as salbutamol, and Advair may be available as Seretide in other countries. International equivalents of common prescription drugs can be looked up by the healthcare provider utilizing

a reference source, such as MD Consult (www.drugs.com/international) or other online databases.

Travelers with asthma should have a peak flow meter (PFM) and know how to use this device for self-assessment of subtle exacerbations of their condition while traveling. Recent evidence-based research has determined that β2-agonists and systemic corticosteroids remain the cornerstone of emergency treatment. Specific instructions on when and how to self-treat an exacerbation, based on PRM measurement, should be given. Depending on the travel itinerary and circumstances, the traveling patient should include short-acting bronchodilator multidose inhalers (MDIs), one or more courses of an oral steroid, and an adequate supply of leukotriene modifiers, if appropriate, as this medication is often unavailable in many countries outside the United States and Europe. National Asthma Education and Prevention Program Guidelines (2007) state there is no evidence to suggest that oral antibiotics are useful in the treatment of acute asthma. Medications for treatment of viral influenza (e.g., oseltamivir) and extra steroid MDIs and oral steroids should be carried in the travel medicine kit (Chapter 1).

To summarize:

- All patients with underlying significant pulmonary disease such as COPD, sarcoidosis, or pulmonary hypertension who will be traveling on flights longer than 1.5 hours in duration should be evaluated for in-flight supplemental oxygen.
- Any patient who uses oxygen at home, even if only at night, will likely require in-flight oxygen supplementation.
- Airlines are no longer required to carry oxygen on board for use in emergencies, and when they do have oxygen, it is often a small canister that would not last very long.
- Third-party oxygen distributers are capable of organizing all aspects of supplemental oxygen, from advising on the correct physician-generated paper work to delivery and collection of oxygen concentrators.

CARDIOVASCULAR DISEASE

In patients with cardiopulmonary disease, the hypoxemia that develops during travel by jet may produce symptoms during prolonged commercial flights. Cardiac events are the most common cause of in-flight emergencies, causing up to 20% in some studies. Supplemental oxygen will be required for any cardiac patient requiring supplemental oxygen at sea level. A recent study of travel safety perceptions and awareness in patients with cardiopulmonary disease revealed that only 19% were aware that the aircraft is pressurized to a cabin altitude of 5000-8000 ft, yet 50% of those studied had symptoms of hypoxia when they traveled by air. Some 81% had dyspnea, and almost 20% some degree of chest discomfort. It is important for the clinician to educate cardiopulmonary patients on the health risks of air travel and assure they are fit to fly and prepared.

Patients should be sure to carry their prescribed medications in their carry-on baggage, as well as copies of recent medical records (electrocardiogram, vital signs, list of diagnoses, list of prescription medication and doses, and names and telephone numbers of their medical providers). Salty foods, carbonated beverages, immoderate consumption of alcoholic beverages, and fatty or spicy foods should be avoided during flight. Bringing healthy snack foods from home is a good precaution against unsuitable airline food. Passengers should walk around the aircraft cabin periodically and/or flex and extend their lower extremities while seated at least once an hour to decrease venous stasis and pooling, keeping in mind that light exercise during air flight can actually worsen hypoxemia in those at risk.

A study of medical emergencies among commercial air travelers by Peterson et al. (2013) found that the flight tower communications center received calls for about 11,920 in-flight medical emergencies among an estimated 744 million airline passengers during the 30-month study period, for a rate of 16 medical emergencies per 1 million passengers, or one in-flight emergency per 604 flights. The most common medical issues were syncope or presyncope (37.4%), respiratory symptoms (12.1%), and nausea or vomiting (9.5%), with some variation

across airlines. Approximately 7.9% of flights were diverted due to an in-flight emergency.

Of individuals requiring assistance for a medical problem during travel, the majority of emergencies among air travelers occurred within the air terminal. Only 25% experienced their problem during the flight. Although the rate of medical emergencies for inbound passengers was low, studies suggest that given the volume of passengers involved, a large number of people can be anticipated to experience medical problems requiring emergency assistance during air travel or in the hours immediately before or after the flight. Thirty-eight in-flight cardiac arrests were reported in the Peterson et al. study, and 31 of these resulted in death. Despite the low rate of medical emergencies, almost 1000 lives are lost annually from cardiac arrest in commercial aircrafts and airport terminals. Most of these individuals do not have a prior history of cardiac disease. In June 2001, the FAA mandated that all commercial air carriers carry automated external defibrillators (AEDs) on each aircraft. Since April 2004, all commercial aircraft now have AEDs on-board.

Given the physical and emotional stress on passengers in air terminals as they rush to cover relatively long distances on foot to make connecting flights, and the often lengthy pre-departure security checks, several commonsense tips for air travelers could be given:

1. Allow plenty of time for travel to the airport, airport parking, standing in line at the ticket counter to check in, and passage through security checks to get to the departure gate. Arrive at the airport at least 2 hours ahead of departure time for domestic flights and 3 hours or more ahead of departure time for international flights.
2. At the time the ticket is booked, request an aisle seat, for increased mobility and leg room (although the aisle seat places a passenger at increased risk of injuries from baggage falling out of overhead bins, should the aircraft experience severe turbulence, compared with a window seat).
3. Request special in-flight meals (low salt, vegetarian, etc.) in advance, at the time the ticket is booked. Special meals are almost always delivered prior to the regular food service.
4. Request assistance by wheelchair or airport motor cart for transport within the airport terminal if there are problems with ambulation, exercise tolerance, or any other disabilities.
5. Pack lightly and utilize luggage with wheels or a baggage cart for transport of carry-on bags within the terminal.
6. Wear comfortable clothing in layers that can be added for warmth or removed for cooling, and wear comfortable "broken-in" low-heeled walking shoes for travel. Loosen laces on footwear when settling in for the flight or change into slippers or airline socks. For long-haul flights, special socks that are designed to decrease venous stasis (e.g., T.E.D. antiembolism stockings) are recommended.
7. Do not place medications or products that may require immediate access in the overhead bins. Medicines such as bronchodilators, insulin, glucose tablets, and nitroglycerin should be placed under the seat or in the seat pocket in front of the traveler where they can be easily accessed if needed.

Patients with a history of cardiac disease may want to consider purchasing medical emergency evacuation insurance. They should review the policy to ensure that they will be covered for pre-existing conditions and should determine if the level of evacuation will meet their needs. Some of these companies will provide a fully equipped and staffed air ambulance (fixed-wing or helicopter) to evacuate a cardiac patient to the nearest regional medical center that could provide a level of care similar to the standard of care available in the patient's home country. Other companies will evacuate a patient to the nearest in-country medical center, where the care may or may not approximate prevailing Western standards. Sometimes the outcome of the evacuation is determined by weather, environment, availability of aircraft and fuel, and political factors.

Guidelines of the Aerospace Medical Association state that commercial airline flight is contraindicated within 3 weeks of an uncomplicated myocardial infarction (MI), within 6

weeks of a complicated MI, within 2 weeks of coronary artery bypass surgery, and within 2 weeks of a cerebrovascular accident. Other contraindications to commercial flights include unstable angina, uncontrolled congestive heart failure, and/or uncontrolled cardiac dysrhythmias and severe symptomatic valvular heart disease. Travelers with acute onset of these conditions should defer travel until these conditions have been stable for 3 months.

Cardiac Pacemakers and Implantable Cardiac Defibrillators

Travelers with implanted cardiac pacemakers and implantable cardiac defibrillators (ICDs) should have a thorough cardiac evaluation before extended overseas travel. The model and lot number of the device, as well as a copy of the patient's electrocardiogram with and without the pacemaker activated, should be carried on the trip along with the other important documents (passport, immunization booklet, traveler's health history; see Chapter 1). Identification of potential medical resources along the planned itinerary is advised, as not all types of medical facilities stock replacement batteries, pacemaker units, and electrodes. When undergoing airport security clearances, the traveler with an ICD or pacemaker should request a hand search, if possible, due to theoretical risk that the magnetic field created by handheld wands may be detected by an ICD and inadvertently lead to a defibrillator shock or inhibit a pacemaker's output. If security personnel insist on using a magnetic wand, ask that they avoid placing or waving the wand over the heart device.

Regarding pacemaker checks for integrity, travel within the continental United States is usually without problems, since many pacemaker patients can have their units checked via electronic telephone diagnostic programs. Medtronic, one of the manufacturers of ICDs, offers local support for their devices in more than 120 countries. Major pacemaker manufacturers and distributors maintain websites that list hospitals and physicians overseas who can evaluate pacemakers and other ICDs. A pacemaker or ICD identification code form is available from local branches of the American Heart Association. Prior to traveling with implanted heart devices the traveler should discuss his or her plans with the cardiologist and ask about specific activity restrictions or recommendations, steps to take if discomfort or symptoms occur, and location of a heart center or specialist at the travel destination.

DIABETES MELLITUS

Travelers with diabetes need to consider how to adapt their treatment programs to unfamiliar foods, irregular schedules, and varying amounts of exercise. Good planning and advance preparation are key to avoiding stress and problems arising as a result of traveling with diabetes. It is important to make plane and hotel reservations in advance and to allow reasonable time between connecting flights. Organize assistance ahead of time if the connection time will be a problem. Schedule necessary travel immunizations several weeks before travel. In addition to the usual travel vaccines, patients with diabetes should be encouraged to receive an annual flu shot, as well as the pneumococcal polysaccharide vaccine.

Table 16.3 lists supplies and medications that patients with diabetes need to assemble before departure. The American Diabetes Association is an excellent additional source of information for the traveler with diabetes. They distribute *The Diabetes Travel Guide*, by Davida F. Kruger. The second edition, published in 2006, includes information about diabetes supplies and a guide to insulin manufactured in the United States and abroad. Insulin manufactured in the United States is sold as U-100 strength, but it can be sold as U-40 or U-80 overseas.

The goal of management of diabetes while traveling is actually very simple: to avoid hypoglycemia. Clinical expertise of experienced diabetes clinicians indicates that complicated medication adjustment plans are unhelpful and can confuse patients. It is best to aim for a plan that will involve a single dose change. The management of diabetes is usually based on a 24-hour medication schedule. When traveling north or south, no adjustments in the 24-hour schedule are needed. Traveling westward results in a longer day, and traveling eastward results in a shorter day. When five or fewer time zones are crossed, no change is

TABLE 16.3 Checklist of Supplies for Insulin-Dependent Patients

Insulin sufficient to last the entire trip plus at least 1 extra week
Disposable U-100 syringes and needles to last entire trip plus 1 week
At least 1 bottle of Humalog (lispro) or other rapid-acting insulin analog
Reagent strips and lancets for blood glucose testing
Two blood glucose monitors with extra batteries, one carried on board and the other elsewhere
Ketone-detecting urine test strips (for use during illness or at altitude)
Glucose tablets and glucose gels
Glucagon emergency kit
Snacks: PowerBars, peanut butter crackers, and fruit juice, to take on board
Diabetes identification tag or bracelet (MedicAlert)
Billfold card detailing insulin dose and doctor's name and telephone number
Signed statement from personal physician on letterhead stationery documenting medical diagnosis and necessity for carrying supply of insulin, syringes, and needles for diabetic treatment, as well as original prescription labels on syringes and medications
Prescription from personal physician detailing insulin dose, in case supplies from home are lost, damaged, or stolen
All oral medications, including antibiotics, antiemetic and antidiarrheal agents, as well as essential over-the-counter medications

required in the usual insulin routine. However, when six or more time zones are crossed, adjustment in the usual schedule is advisable. The timing for oral diabetic medication is not as critical as that for insulin. People taking pills for their diabetes should simply take their medicine at the prescribed time, using local time. Patients wearing an insulin pump (continuous subcutaneous insulin infusion therapy) usually will *not* have to make adjustments in their basal insulin rates as they travel. However, it is important for patients with diabetes who use an insulin pump that they continue to check their blood sugars frequently after they arrive. It takes approximately 3-4 days for the body to adjust to a new time zone, and therefore, on the third day, the time on the insulin pump should be set to the local time. All the other settings should remain the same. Most airport security personnel in major international airports are familiar with insulin pumps. The events of 9/11 have increased security to the point that often the security agent will ask the pump wearer to open the back of the pump. This is a reasonable and easy request for some, but not all pumps, so it is often easiest to simply disconnect the device and let it be scanned through the screening machine. To facilitate easy removal of the pump, it should be stored in an easily accessible place such as a front pants or skirt pocket. It may be useful to carry a letter from one's physician explaining the need to travel with diabetes supplies and to provide a list of the supplies for airport security personnel. It is important to assure adequate pump supplies are carried with the traveler or split between carry-on and checked luggage. Many pump manufacturers have a back-up pump lending program; having a back-up pump is always recommended when traveling for an extended amount of time. Additionally, it is essential that those using a pump learn how to convert to a basal-bolus insulin regimen in the event of pump failure. They should have stored on paper as well as their smartphone or other device the amount of insulin they use in their pump as basal insulin as well as the amount they typically use as a pre-meal bolus. This information will allow a smooth conversion to a basal-bolus injection regimen. The basal rate can be substituted with a long-acting basal insulin (glargine or detemir), if needed.

Security regulations require that syringes, infusion sets, and other sharps retain the original pharmacy label stating the health provider's name. Frequent blood sugar monitoring is essential for safety. In addition to the typical measurements before breakfast, lunch, and dinner, travelers should check blood glucose levels every 3-4 hours while awake and

whenever their daily routine is disrupted. Individuals who are normally lax about home glucose monitoring should *not* be while traveling. Most significant problems associated with fluctuations in blood sugars can be avoided by frequent checking of blood sugars. It is essential that travelers with diabetes have an adequate supply of the proper blood glucose strips for their particular meter and that they have batteries and even a back-up meter to use should they have a problem with their meter. Because the traveler will be ideally checking blood sugars more frequently, the healthcare provider may need to write a new prescription to take into account an increased number of glucose monitoring strips. Medical providers in former British colonies as well as the United Kingdom use meters and strips based on the millimoles per liter system and not on the more familiar milligrams per deciliter system that US meters report. A patient unfamiliar with this system of reporting would not be able to adequately interpret the data, so it is best to bring an extra meter and strips from home. The patient should have clear instructions regarding the management of high blood sugars while flying.

Diabetes and High Altitude

It is important to note that meters are not quite as accurate at altitude, but a study by Olateju et al. (2012) determined that while slight overestimation of blood glucose concentrations was found among various meters tested, no results obtained would have resulted in a failure to detect and treat blood glucose results requiring intervention. A study by de Mol et al. (2010) looked at a number of factors affecting the accuracy of handheld blood glucose meters at high altitude both simulated and on Mt. Kilimanjaro and found that of the nine different meters tested, the Accu-Chek Compact Plus and Accu-Chek Contour meters were the most accurate. A review article by Richards and Hillebrandt in 2013, found that highly motivated trekkers with type 1 diabetes who were free from long-term complications had metabolic and cardiovascular profiles comparable to those of control subjects, even though metabolic control was slightly worse. Despite the shortcomings in accuracy of blood glucose meters at altitude, frequent monitoring of blood glucose is required to remain safe from acute complications at altitude.

Traveling East across Six or More Time Zones

Traveling east shortens the day. There are a number of references dealing with the adjustment of insulin doses during travel through multiple east-to-west or west-to-east time zones. Studies demonstrate that straightforward and simple advice with regard to insulin management while traveling is preferred to elaborate protocols to alter insulin dosages, and usually adequate blood glucose control can be maintained with just one change in protocol. Regardless of the protocol used to adjust medications, patients should be advised to check blood glucose levels frequently during the flight and carry a quick-acting carbohydrate source that can be reached without having to leave the seat. Airline diabetic meals are not standardized, and therefore it is not necessary to order these. However, ordering a "Hindu," "low salt," or "vegetarian" meal will likely guarantee that the meal will be delivered prior to the regular meal service. More importantly, all insulin-using patients should be taught how to count carbohydrates and adjust rapid-acting insulin injections based on the quantity of carbohydrates to be consumed. There are excellent resources available for counting carbohydrates, and many of these are apps that can be downloaded to a smartphone or other handheld electronic device. A Certified Diabetes Educator or nutritionist can instruct the patient contemplating travel in how to master this task, which will go a long way to improving diabetes control while traveling. This teaching should occur well in advance of the planned trip.

Patients planning a long trip across many time zones may be greatly benefited by switching from regular insulin to one of the recombinant insulin analogs—Humalog (Lispro), NovoLog (insulin aspart), or Apidra (glulisine)—if they have not already done so. They should initiate this change at least 2 months before the trip so that baseline doses can be well established prior to travel. These agents have a rapid onset of action and can be taken

with a meal, unlike regular insulin that must be injected at least 30 min before a meal to avoid postprandial hypoglycemia. Another significant advantage of recombinant insulin analogs is that it remains in the body for a maximum of 2-4 hours, thereby decreasing the likelihood of between-meal hypoglycemia.

Humalog or NovoLog insulin pen injection devices make administration of insulin extremely easy. Insulin pens look like large pens with cartridges. They can be used with small pen-tip needles instead of syringes and needles for giving insulin injections. A fine short needle, like the needle on an insulin syringe, is screwed onto the tip of the pen. Users turn a dial to select the desired dose of insulin and press a plunger on the end to deliver the insulin just under the skin. NovoLog Insulin pens are made by Novo-Nordisk and Humalog Insulin pens by Lilly. Pen needle tips are manufactured by Becton Dickinson.

The patient should be advised to work with a diabetes educator to determine the amount of quick-acting insulin that should be used to conservatively lower blood glucose if it is above the target range. For example, if a person is told to take one unit of insulin to lower the blood glucose by 50 points, he or she should use this ratio to correct hyperglycemia 3-4 hours after eating, while traveling.

When flying east, the day becomes shorter, so the basal dose of insulin should be adjusted using the formula:

$$\text{Travel dose} = \text{Normal dose} \times \left(0.9 - \frac{\text{Number of time zones crossed}}{\text{Hours between basal insulin doses}}\right).$$

This formula calculates the amount of insulin required to bridge the gap between the departure dose on the day of travel and the dose given after arrival, and takes into consideration the shortened day. It reduces the amount of insulin by a factor of 10-20% depending on the length of travel. For example: Jane has insulin-dependent diabetes and is traveling home from Nome, Alaska to New Jersey. She takes 20 units of Lantus (glargine) insulin at 8 p.m. every night as basal insulin. Using the formula above, which is fully explained in **Figure 16.1**, she would take her normal 20 units of Lantus the night before travel while in Nome. She would keep her watch on Nome time at 8 p.m. While flying, she would take 13 units. She would then change her watch to Eastern Standard Time at her destination. The next dose of Lantus is due at 8 p.m. EST after she arrives in New Jersey, which turns out to be only 18 hours after the last dose. The reduced time between doses is why the patient took just under three-quarters of her usual Lantus (glargine) dose on the flight. An excellent full explanation of these simple adjustments, including superb patient handouts, freely available to clinicians, can be found in Pinsker et al. (2013).

Traveling West Across Six or More Time Zones

Individuals on a basal-bolus insulin regimen flying west across six or more time zones should keep their watches set on their home time zone and should take their half of their basal insulin dose at the time they normally do. On arrival at their destination they should change the time on their watch to local time and take the remainder of their basal insulin at the time they normally would back home. By splitting the dose in half and at two different times, the Lantus (glargine) dose is extended to cover the entire day and will then put them back on schedule. On a twice-dosing basal regimen, the same protocol can be adopted with the same "one change" protocol. The patient would take their total dose of basal that they normally take in the morning prior to flying. The second dose would be due in-flight, so they should take half of that dose at the time they normally would. Then on arrival at their destination, they adjust their watch to local time and take the second half of their basal dose at the usual time. For example: Joe takes detemir 10 units twice per day at 9 a.m. and 9 p.m. He would take the full 10 units at 0900 and keep his watch on Newark time, his departure location. At 2100 in-flight, he would take half (5 units) of his detemir, and then when he arrives at his destination, take the additional 5 units at 2100 local time. At 0900 the next day, he is back on his regular schedule. He can continue to bolus before meals based on blood sugar results and carbohydrate intake, as always. Using a smartphone

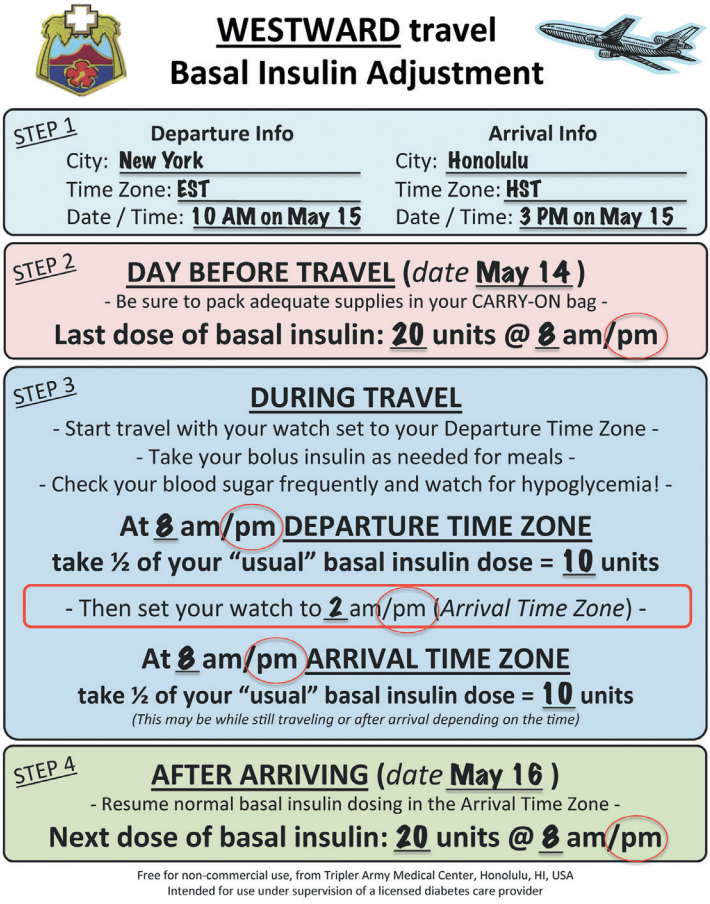

Fig. 16.1 Formula for westward travel. (Reprinted with permission from Pinsker, J.E., et al., 2013. Extensive clinical experience: a simple guide to basal insulin adjustments for long-distance travel. J. Diabetes Metabol. Disord. 12, 59.)

application or checking www.worldtimezones.com can help one determine how many time zones will be crossed.

Regardless of the method used to adjust insulin dosages while traveling, it is essential that the person on insulin therapy understands how to recognize and treat hypoglycemia, how to monitor and interpret blood glucose results, and how to adjust insulin for a decrease or increase in the amount of carbohydrate present in the meal. A visit to a Certified Diabetes Educator or an endocrinologist with a special interest in diabetes prior to travel can be invaluable. These professionals can suggest individualized programs of insulin management to address changes in time zones, exercise levels, and illnesses while traveling. They can assist the Type 1 DM patient in switching from their pump to a long-acting insulin for basal needs with short-acting insulin alalogs for pre-pradial boluses and management of high

blood sugars. With the improvements in insulin products available today, there is no reason that the individual with type 1 diabetes needs to suffer poor control of blood sugars while traveling.

Prevention of Hypoglycemia

Travel usually involves a drastic departure from daily routines. Meals may be delayed or unavailable. Physical activity is often greatly increased. These factors increase the risk of hypoglycemia. The principle of eating extra food when engaged in extra activity becomes especially important when traveling. Suitable snacks, such as crackers, dried fruits, or nuts, should be carried for use if meals are delayed or to supplement meals if necessary. Concentrated commercially available food bars such as Clif Bars, Luna Bars, or PowerBars suit this purpose very well, and for those counting carbohydrates, it is easy to calculate the amount of insulin required per carbohydrate as they are quantified on the label of the food bar.

Persons with diabetes should receive instruction from their diabetes care provider on recognition and treatment of hypoglycemia. A person with hypoglycemia may feel weak, drowsy, dizzy, or confused. Paleness, headache, trembling, sweating, rapid heartbeat, and a cold, clammy feeling are also signs of low blood sugar. The best method for treating very low blood sugar is with commercially available Gluco-Gel or Glucose Gel. These tubes are very quick acting. For low blood sugar levels that are only slightly below target, it is safe to use commercially available glucose tablets. One tablet is the equivalent of 4 g of glucose, so it will take three to four to raise a blood sugar level of 50 mg/dl into a safe zone. These commercially available products to treat hypoglycemia are highly recommended because they have a measured amount of concentrated carbohydrate content and are very stable. Liquid products such as Gluco-Gel or GU Energy Gel tend to work much faster and can be inserted into the patient's mouth, with no chewing necessary.

Traveling companions should be advised of the early signs of hypoglycemia and should understand the importance of administering sugar-containing drinks, or one of the products described above, if the person becomes glassy-eyed, grows confused or irritable, or is noted to be sweating inappropriately. If the person is too confused to swallow, food or fluid should not be administered, but Gluco-Gel can safely be administered into the mouth. If the situation worsens or cannot be treated orally, glucagon should be administered by injection.

Anyone using insulin as part of his or her diabetes treatment should travel with a glucagon emergency kit. Traveling companions should be briefed on proper use of the glucagon emergency kit. If the patient on insulin is traveling with a tour group, then the tour group leader or the person assigned to deal with medical problems for the group should be briefed on the use of glucagon and should be familiar with the kit and where the traveling patient is carrying it. For a lengthy trek, it is good to have more than one kit: one to be carried by the patient and one by the trip leader or medical support.

The traveler with diabetes who becomes stuporous or unconscious needs skilled medical care as soon as possible. However, one should *not* delay the administration of glucagon while attempting to obtain skilled medical care. Giving glucagon to a person with diabetes who does not need it may cause a significant rise in blood sugar, but this can be corrected relatively simply. Delaying glucagon administration in a diabetic person with severe hypoglycemia could result in severe medical complications. Glucagon can be administered by injection, even if the person of concern is stuporous or seizing. Any route of administration is reasonable, including intramuscularly or subcutaneously in an emergency situation. Once glucagon is administered, if the person regains full consciousness and is able to take food orally, a carbohydrate-protein snack should be given.

Names of English-speaking physicians overseas can be obtained from a number of sources listed in the Appendix. In addition, the Consulate of the American Embassy will have a list of physicians available to American citizens traveling abroad. It is important for all American citizens, particularly those with chronic medical problems, to register through the Smart Traveler Enrollment Program, a free service to allow US citizens and nationals traveling

abroad to enroll their trip with the nearest US Embassy or Consulate. This service can be accessed at https://step.state.gov and can be completed before travel. Addresses and phone numbers of American Embassies overseas can be found at www.state.gov.

ARTIFICIAL HIP JOINTS AND OTHER ORTHOPEDIC HARDWARE

The metal components in artificial hip replacements and metal pins used for internal fixation of bone fractures may trigger the electromagnetic security alarms at airport passenger check-in stations. A traveler with an implanted orthopedic device or hardware should download the pdf "Disability Notification Card for Air Travel," which is available at www.tsa.gov. It is a card that can be presented to the security staff and simply states the medical condition and that alternate screening methods such as imaging or manual pat-down can be used. A passenger with metal implants can also request screening by imaging technology if it is in use at check-point. This may avoid lengthy explanations and delays in departure.

INTERNET RESOURCES

Access-Able Travel Source (www.access-able.com)
American Diabetes Association (www.diabetes.org)
American Lung Association (www.lungusa.org)
American Thoracic Society (www.thoracic.org)
British Thoracic Society (www.brit-thoracic.org.uk)
The International Society of Travel Medicine (www.istm.org)
The Oxygen Traveler (www.theoxygentraveler.com)
US Department of State (www.state.gov)
US Transportation Security Administration (www.tsa.gov)

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A comprehensive guide for those with diabetes planning a trip to anywhere in the world, with numerous sources for further information.

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Peterson, D.C., et al., 2013. Outcomes of medical emergencies on commercial airline flights. New Engl. J. Med. 368, 2075–2083.

Pinsker, J.E., et al., 2013. Extensive clinical experience: a simple guide to basal insulin adjustments for long-distance travel. J. Diabetes Metab. Disord. 12, 59.
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