Table 3-06 Accommodations & human rights frameworks for people with disabilities: information sources for travelers

ORGANIZATION/SOURCE	RESOURCE	AVAILABLE FROM	NOTES
US Department of State	International Travel	https://travel.state.gov/content/travel/en/international-travel.html	To find information on accessibility for travelers with mobility limitations, enter a country or area in the search bar titled: *Learn about your destination*. Information on accessibility can be found in the section: *Local Laws and Special Circumstances*
	Country Reports on Human Rights Practices (Human Rights Reports)	www.state.gov/reports/2019-country-reports-on-human-rights-practices	Select a year and country, then read section 6 of the report for information about the human rights and social service framework protecting citizens with disabilities in the destination country

Under the guidelines of the ACAA, when a traveler with disability requests assistance, the airline is obliged to meet certain accessibility requirements. For example, carriers must provide access to the aircraft door (preferably by a level entry bridge), an aisle seat, and a seat with removable armrests. However, aircraft with <30 seats generally are exempt from these requirements. Any aircraft with >60 seats must have an onboard wheelchair, and personnel must help move the onboard wheelchair from a seat to the lavatory area upon request. Only wide-body aircraft with ≥2 aisles are required to have fully accessible lavatories.

Airline personnel are not required to assist with feeding, visiting the lavatory, or dispensing medication to travelers. Travelers with disabilities who require this type of assistance should travel with a companion or attendant. DOT maintains a toll-free hotline (800-778-4838 [voice] or 800-455-9880 [TTY]), available 9 a.m. to 5 p.m. Eastern Time, Monday–Friday, except federal holidays, to provide general information to consumers about the rights of air travelers with disabilities and to assist air travelers with time-sensitive disability-related issues.

Many non–US airlines voluntarily adhere to codes of practice that are similar to US legislation based on guidelines from the International Civil Aviation Organization (ICAO; see Table 3-05). These guidelines are not identical to those outlined in US legislation, however, and the degree of implementation can vary by airline and location. Travelers planning to fly between foreign countries or within a foreign country while abroad should check with the overseas airlines to ensure that the carriers adhere to accessibility standards adequate for their needs. ICAO (see Table 3-05) also provides accessibility scores for airports across the world that can aid in travel planning.

Assistive Devices

Assistive devices can make traveling more accessible for people with disabilities. Travelers and their health care providers can consult the DOT and Transportation Security Administration (TSA) websites (see Table 3-05) for information on traveling with an assistive device. Travelers should check for specific policies for assistive devices, including wheelchairs, portable machines, batteries, respirators, and portable oxygen concentrators.

In-Flight Services

Airlines are not permitted to require travelers to provide advance notice of a disability. Airlines might require up to 48 hours advance notice and 1-hour advance check-in, however, for certain

accommodations that require preparation time for services (if they are available on the flight), such as medical oxygen for use on board the aircraft, carriage of an incubator, hook-up for a respirator to the aircraft electrical power supply, accommodation for a passenger who must travel in a stretcher, transport of a battery-powered wheelchair on an aircraft with <60 seats, provision by the airline of hazardous material packaging for batteries used in wheelchairs or other assistive devices, accommodation for ≥10 people with disabilities who travel as a group, or provision of an onboard wheelchair for use on an aircraft that does not have an accessible lavatory.

All audiovisual displays played on aircraft for safety and informational purposes must use captioning or a sign language interpreter as part of the video presentation. The captioning must be in the predominant languages in which the carrier communicates with passengers on the flight. The current ACAA rule does not require the captioning of in-flight entertainment.

AIRPORT ACCOMMODATIONS

Security Screening

The TSA has established a program for screening travelers with disabilities and their equipment, mobility aids, and devices. TSA permits prescription liquid medications and other liquids needed by people with disabilities and medical conditions. Travelers with disabilities or medical conditions that affect TSA screening might use a TSA Notification Card to communicate with screening officers; they can also learn more about TSA guidelines for disabilities and medical conditions online (see Table 3-05).

As with other people with disabilities or medical conditions, travelers with hearing loss (i.e., individuals who are deaf or who are hard of hearing) can provide the TSA officer with a notification card or other medical documentation that describes their condition and informs the officer about the need for assistance with the screening process. Travelers are not required to remove any hearing aids or external cochlear implant devices. Additional screening, including a pat-down or device inspection, might be required if assistive devices alarm security technology.

Travelers with disabilities or medical conditions can call the TSA helpline toll free at 855-787-2227, federal relay 711, or check TSA's website (www.tsa.gov/travel/special-procedures) for answers to questions about screening policies, procedures, and the security checkpoints.

Closed Captioning

As part of the ACAA, DOT rules require any airport terminal facility that receives federal financial assistance to enable or ensure high-contrast captioning at all times on televisions and other audiovisual displays. Captioning is required on televisions and other audiovisual displays located in any common area of the terminal to which passengers have access, including the gate area, ticketing area, passenger lounges, and leased commercial shop and restaurant spaces.

Telecommunication Devices

Current ACAA rules require people with hearing loss to self-identify to airline carrier personnel to ensure their receipt of accessible information. Passenger information, including information about flight schedule changes, connections, gate assignments, and baggage claim must be transmitted in a timely manner through an accessible method of communication to those who have identified themselves as having hearing loss.

Passengers with hearing loss must identify themselves to carrier personnel at the gate area or the customer service desk even if they have already done so at the ticketing area. The ACAA rules do not require a sign language interpreter to ensure that a passenger with hearing loss receives all pertinent information. If an airline carrier provides telephone reservation and information service to the public, these services must be available to people with hearing loss through a telecommunications device for the deaf (TDD), telecommunications relay services, or other technology.

Wheelchairs

Travelers can decide to rent wheelchairs and medical equipment at their destination. Research on renting wheelchairs might include checking the availability of wheelchair and medical equipment providers. In addition, organizations such as Mobility International USA (www.miusa.org) have

information about overseas medical equipment providers. The country voltage, type of electrical plug, and reliability of the electrical infrastructure at the destination country might make one type of wheelchair preferable over another. In some cases, a manual instead of a power wheelchair is the preferred assistive device.

BOARDING & DEPLANING WITH A WHEELCHAIR

Smaller airplanes might not have a jetway, and travelers who use wheelchairs might need to be manually lifted or carried down the stairs. Some airports have adapted hoists or lifts. An aisle chair is usually required to board and deplane an airplane. Travelers should be sure to mention they need an aisle chair, both when reserving tickets and when checking in at the airport. Additional wheelchair traveling tips are available through Wheelchair Travel's Wheelchair Users' Guide to Air Travel (https://wheelchairtravel.org/air-travel).

SERVICE ANIMALS

Some travelers require a service animal for travel support. Travelers who require service animals, including emotional support animals, should check with the airline and the destination country to ensure that both will permit the animal and that the traveler obtains all required documentation (see Sec. 7, Ch. 6, Traveling with Pets & Service Animals). Clinicians can use the following recommendations to assist travelers with service animals. Travelers can contact the foreign embassy or consulate of the destination country for information on possible restrictions and cultural norms about service animals. Travelers should find out about any required quarantine, vaccination, and documentation for the service animal; consult their veterinarian for tips about traveling with service animals; and contact destination hotels to make certain they will accommodate service animals.

CRUISE SHIPS

Companies or entities conducting programs or tours on cruise ships that dock at US ports have obligations regarding access for travelers with disabilities, even if the ship itself is of foreign registry, as outlined in Title III of the Americans with Disabilities Act (www.ada.gov/regs2010/titleII_2010/titleIII_2010_regulations.htm). All travelers with disabilities should check with cruise lines regarding availability of requested or needed items before booking. Cruise ship operators and travel agents that cater to travelers with special needs also exist.

BOX 3-02 Managing chronic health conditions during international travel: a checklist for travelers

BEFORE TRAVEL

- ☐ Contact your health insurance carrier or review your health insurance plan. If your insurance does not provide overseas coverage, the US Department of State strongly recommends purchasing supplemental medical insurance and medical evacuation plans.
- ☐ Visit the US Department of State's Your Health Abroad webpage (https://travel.state.gov/content/travel/en/international-travel/before-you-go/your-health-abroad.html).
- ☐ Visit the Centers for Disease Control and Prevention, Travelers' Health website (https://wwwnc.cdc.gov/travel/) for health actions before, during, and after travel.

DURING TRAVEL

- ☐ Carry medical alert information and a letter from your health care provider describing medical conditions, medications, potential complications, and other pertinent medical information.
- ☐ Carry enough prescription medication to last the entire trip, including extra medicine in case of delay. Carry prescriptions in their labeled containers, not in a pill pack.
- ☐ Some prescription medications that are legal in the United States are illegal in other countries. Contact the US embassy or consulate at your destination (www.usembassy.gov) to learn more about bringing prescription medicines overseas.

MEDICAL CONSIDERATIONS

Some travelers can have both a disability and an underlying health condition. Box 3-02 provides a list of suggestions the travel health provider can use to help the traveler plan to manage their condition while abroad. For more details, refer to Sec. 3, Ch. 3, Travelers with Chronic Illnesses.

BIBLIOGRAPHY

Barnett S. Communication with deaf and hard-of-hearing people: a guide for medical education. Acad Med. 2002 Jul; 77(7):694–700.

Bauer I. When travel is a challenge: travel medicine and the "dis-abled" traveler. Travel Med Infect Dis. 2018:22;66–72.

International Civil Aviation Organization. Manual on access to air transport by persons with disabilities. Montréal: International Civil Aviation Organization; 2013. Available from: www.skywisesolutions.com/files/manual_on_access_to_air_transport_by_persons_with_disabilities_-_icao.pdf.

The National Association of the Deaf. Legal rights, 6th edition: The guide for deaf and hard of hearing people. Washington, DC: Gallaudet University Press; 2015.

US Department of Transportation. Nondiscrimination on the basis of disability in air travel. Available from: www.govinfo.gov/content/pkg/FR-2018-05-23/pdf/2018-10814.pdf.

World Health Organization. International Classification of Functioning, Disability and Health (ICF). Geneva: The Organization; 2001. Available from: www.who.int/standards/classifications/international-classification-of-functioning-disability-and-health.

TRAVELERS WITH CHRONIC ILLNESSES

Noreen Hynes

Although traveling abroad can be relaxing and rewarding, the physical demands of travel can be stressful, particularly for travelers with underlying chronic illnesses. With adequate preparation, however, these travelers can have safe and enjoyable trips. For more detailed information on assisting immunocompromised travelers, travelers with disabilities, highly allergic travelers, and travelers with substance use disorders prepare for international travel, see the respective chapters in this section.

Patients should see their established health care providers well in advance of travel to ensure that all chronic conditions are controlled, and management is optimized. Clinicians should encourage patients to seek pretravel consultation prior to paying for nonrefundable trips, and at least 4–6 weeks before departure to ensure adequate time to respond to immunizations, try new medications before travel, or redefine the itinerary based upon pretravel consultation recommendations.

GENERAL APPROACH

Advising Travelers

Adequate preparation for patients with chronic illnesses for international travel requires the active participation of both the traveler and the travel health provider. Box 3-03 includes a checklist of pretravel activities for travelers with chronic illnesses.

Health Care Provider Roles & Responsibilities

Health care providers play a critical role in helping patients with chronic underlying conditions travel safely. Ask patients about previous health-related issues encountered during travel (e.g., complications during air travel). In addition to sharing the advice found in Box 3-03, ensure the traveler has sufficient medication (and proper storage conditions) for the

BOX 3-03 A checklist for travelers with chronic illnesses preparing for international travel

- ☐ Carry copies of all prescriptions.
- ☐ Check with the foreign embassy or consulate for your destination country in the United States to clarify whether any medication restrictions exist. Some countries do not allow visitors to bring certain medications into the country, especially narcotics and psychotropic medications.
- ☐ Favor travel to destinations that have access to quality care for your condition (see Sec. 6, Ch. 2, Obtaining Health Care Abroad)
- ☐ Obtain an established provider letter. The letter should be on office letterhead stationery and outline existing medical conditions, medications prescribed (including generic names), and any equipment required to manage the condition. By law, some states do not permit a travel health specialist to furnish such a letter if the specialist is not also the primary care provider or established provider of record.
- ☐ Pack a travel health kit (see Sec. 2, Ch. 10, Travel Health Kits). Take health kits on board as carry-on luggage, and bring all necessary medications and medical supplies (e.g., pouching for ostomies) in their original containers.
- ☐ Select a medical assistance company that allows you to store your medical history so it can be accessed worldwide.
- ☐ Sign up for the Smart Traveler Enrollment Program (https://step.state.gov/step), a free service of the US Department of State to US citizens and permanent residents, to receive destination-specific travel and security updates. This service also allows the Department of State to contact international travelers during emergencies.
- ☐ Stay hydrated, wear loose-fitting clothing, and walk and stretch at regular intervals during long-distance travel (see Sec. 8, Ch. 3, Deep Vein Thrombosis & Pulmonary Embolism).
- ☐ Wear a medical alert bracelet or carry medical information on your person. Various brands of jewelry or tags, even electronic ones, are available.

entire trip, plus extra in case of unexpected delays. Because medications should be taken based on elapsed time and not time of day, offering travelers guidance on scheduling when to take medications during and after crossing time zones might be needed.

Educate travelers on possible drug interactions (see Sec. 2, Ch. 4, Interactions Between Travel Vaccines & Drugs). Some medications used to treat chronic medical illnesses (e.g., warfarin) can interact with prescribed self-treatment for travelers' diarrhea or malaria chemoprophylaxis. Discuss all medications patients use, including medications taken daily, those taken on an as-needed basis, and dietary supplements or herbal products.

In addition, discuss supplemental insurance options for travelers, including policies that cover trip cancellation in the event of illness, supplemental medical insurance, and medical evacuation insurance. Supplemental medical insurance can reimburse travelers for money paid for health care abroad; most medical insurance policies do not cover the cost of health care received in other countries. Medical evacuation insurance covers moving the person from the place of illness or injury to a place where they can receive definitive care. Travelers might need assistance to identify supplemental insurance plans that will cover costs for preexisting conditions (see Sec. 6, Ch. 1, Travel Insurance, Travel Health Insurance & Medical Evacuation Insurance).

Help patients devise a Personal Travel Health Plan. This plan should give instructions for managing minor problems or exacerbations of underlying illnesses and should include information about medical facilities available in the destination country (see Sec. 6, Ch. 2, Obtaining Health Care Abroad).

SPECIFIC CHRONIC MEDICAL CONDITIONS

Chronic illness or acute illness affecting underlying chronic disease might affect the recommendations clinicians make to a traveler after completing

the risk assessment conducted as part of the pretravel consultation (see Sec. 2, Ch. 1, The Pretravel Consultation). Some online resources for travelers who have ≥1 chronic medical conditions can be found in Table 3-05 (in Sec. 3, Ch. 2, Travelers with Disabilities) and Table 3-07.

Chronic conditions include those affecting the cardiovascular, endocrine, gastrointestinal, genitourinary, hematological, hepatic, neurologic, and respiratory systems. Table 3-08 addresses issues and recommendations related to specific chronic medical illnesses and should be used in

Table 3-07 Online resources for travelers with chronic illnesses: disease & condition-specific

DISEASE/CONDITION	ORGANIZATION/SOURCE	RESOURCE	AVAILABLE FROM
ANTICOAGULATION	Anticoagulation Forum	Centers of Excellence Resource Center	https://acforum-excellence.org/Resource-Center
CANCER	American Cancer Society	Eat Right and Stay Active while Traveling	www.cancer.org/latest-news/eat-right-and-stay-active-while-traveling.html
CELIAC DISEASE	National Celiac Association	Eating GF when traveling abroad	https://nationalceliac.org/celiac-disease-questions/eating-gf-when-traveling-abroad
CHRONIC PAIN	International Pain Foundation	Top Tips for Traveling Abroad with Chronic Pain	https://internationalpain.org/top-tips-for-traveling-abroad-with-chronic-pain
DIABETES	American Diabetes Association	Air Travel and Diabetes	www.diabetes.org/resources/know-your-rights/discrimination/public-accommodations/air-travel-and-diabetes
EPILEPSY	Epilepsy Foundation	Travel and Holidays	www.epilepsy.com
	Epilepsy Society (UK)		https://epilepsysociety.org.uk/living-epilepsy/travel
HEART CONDITIONS	American Heart Association	Healthy Travel	www.heart.org/en/healthy-living/healthy-lifestyle/mental-health-and-wellbeing/healthy-travel
INFLAMMATORY BOWEL DISEASE	Crohn's & Colitis Foundation	Traveling with IBD	www.crohnscolitisfoundation.org/what-is-ibd/traveling-with-ibd

(*continued*)

Table 3-07 Online resources for travelers with chronic illnesses: disease & condition-specific (continued)

DISEASE/CONDITION	ORGANIZATION/SOURCE	RESOURCE	AVAILABLE FROM
KIDNEY DISEASE	American Association of Kidney Patients (AAKP)	International Travel while on Dialysis	https://aakp.org/international-travel-while-on-dialysis
	National Kidney Foundation	Foreign Travel Tips for Dialysis Patients	www.kidney.org/newsletter/foreign-travel
	Global Dialysis (UK)	Travel Advice	www.globaldialysis.com/component/content/article/30/75-travel-advice.html
LUNGS & CHEST	American Lung Association	Traveling with Oxygen	www.lung.org/lung-health-diseases/lung-procedures-and-tests/oxygen-therapy/traveling-with-oxygen
MULTIPLE SCLEROSIS	Multiple Sclerosis Foundation	Tips for Traveling Abroad with MS	https://msfocus.org/Magazine/Magazine-Items/Posted/Tips-for-Traveling-Abroad-with-MS.aspx
SLEEP APNEA	American Sleep Association	Travel: CPAP Machines	www.sleepassociation.org/sleep-apnea/cpap-machines/travel
	American Sleep Apnea Association	US Travel Tips for CPAP Users	www.sleepapnea.org/treat/cpap-therapy/us-travel-tips-for-cpap-users/

conjunction with the other recommendations given throughout this book.

Travelers also might want to investigate international health care accreditation agencies to identify health care facilities at the travel destination that have received recognition or accreditation for high care standards and good patient safety records. If travelers or their health care providers have concerns about fitness for air travel or the need to obtain a medical certificate before travel, the medical unit affiliated with the specific airline is a valuable source for information.

Travelers who require service animals, including emotional support animals, should check with the airline and the destination country to ensure both the air carrier and the country will allow the animal; documentation and permits might also be required (see Sec. 7, Ch. 6, Traveling with Pets & Service Animals). Travelers planning to use supplemental oxygen on the aircraft or needing other equipment (e.g., a wheelchair) must inform the airline far in advance of planned travel. The Transportation Security Administration (TSA) Cares Helpline (toll-free at 855-787-2227) or TSA Cares online assistance (www.tsa.gov/contact-center/form/cares) also can provide information on how to prepare for the airport security screening process for a particular disability or medical condition.

Table 3-08 Special considerations for travelers with chronic illnesses

CONDITION	CONTRAINDICATIONS TO & TIMING OF AIRLINE TRAVEL	PRETRAVEL RECOMMENDATIONS & CONSIDERATIONS	IMMUNIZATION CONSIDERATIONS	ADDITIONAL CONSIDERATIONS & GUIDANCE
GENERAL CONSIDERATIONS	Travelers unlikely to survive the flight due to preexisting condition Any traveler with serious and acute contagious disease (e.g., acute, untreated tuberculosis; COVID-19)			
AUTOIMMUNE & RHEUMATOLOGIC DISEASES	None	Baseline TST or IGRA before starting TNF blockers	Immunosuppressive medications including TNF blockers might alter response to immunizations Live attenuated vaccines might be contraindicated	Emphasize safe food and water precautions and good hand hygiene
CANCER	Anemia, severe (Hgb <8.5 g/dL) Cardiovascular, gastrointestinal, or pulmonary/respiratory complications (see below for details) Cerebral edema due to intracranial tumor	Emphasize safe food and water precautions Plan for self-management of dehydration DVT precautions Supplemental oxygen Wear loose-fitting clothing to prevent worsening of lymphedema	Immunosuppressive medications might alter response to travel vaccines Live attenuated vaccines might be contraindicated Revaccination might be necessary after cancer treatment	Check for medication restrictions at the destination (e.g., pain relief/control) See Sec. 3, Ch. 1, Immunocompromised Travelers, for additional recommendations

(*continued*)

Table 3-08 Special considerations for travelers with chronic illnesses (continued)

CONDITION	CONTRAINDICATIONS TO & TIMING OF AIRLINE TRAVEL	PRETRAVEL RECOMMENDATIONS & CONSIDERATIONS	IMMUNIZATION CONSIDERATIONS	ADDITIONAL CONSIDERATIONS & GUIDANCE
CARDIOVASCULAR & OTHER CIRCULATORY DISORDERS[a]	Angina, unstable Arrhythmia, uncontrolled CHF, severe or decompensated Eisenmenger Syndrome Hypertension, uncontrolled Post–acute coronary syndrome *Low risk*: minimum 3 days before travel *Moderate risk*: minimum 10 days before travel *High risk* or awaiting further intervention or treatment: defer air travel until disease is stabilized Post–CABG: minimum 10 days, and improving, before travel Post–percutaneous coronary intervention (elective): minimum 2 days, and no complications, before travel Post–percutaneous pacemaker or implanted defibrillator placement: minimum 2–3 days, if uncomplicated, before travel Post–sickle cell crisis: minimum 10 days post-event, and improving, before travel Valvular heart disease, severe, symptomatic	Supplemental oxygen Plan for self-management of dehydration and volume overload; may include adjusting medications Bring copy of recent ECG Bring pacemaker or AICD card DVT precautions	Influenza Pneumococcal	Have sublingual nitroglycerin available in carry-on bag Mefloquine[b] (antimalarial prophylaxis) not recommended for people with cardiac conduction abnormalities, particularly those with ventricular arrhythmias Provider primarily responsible for prescribing anticoagulation should tailor INR self-monitoring and management regimen
CNS & PNS DISORDERS	Neurologic process, unstable Post–CVA: minimum 10–14 days, and improving, before travel Post–TIA: minimum 3 days, and no recurrence, before travel Post–cranial surgery: minimum 7–14 days, and improving, before travel Seizure disorder, poorly controlled	Mefloquine antimalarial chemoprophylaxis is contraindicated in travelers with underlying seizure disorder; check for drug–drug interactions		Patients with myasthenia gravis: mefloquine & chloroquine antimalarial chemoprophylaxis, and YF vaccine are all generally contraindicated

DIABETES MELLITUS	None	Plan for self-management of dehydration, diabetic foot, and pressure sores Insulin adjustments Check FSBG at 4–6-hour intervals during air travel Discuss changes in insulin or oral agent regimen with diabetes specialist Provide physician's letter stating need for all equipment, including syringes, glucose meter, and supplies	Influenza Pneumococcal Hepatitis B	Keep insulin and all glucose meter supplies in carry-on bag Bring food and supplies needed to manage hypoglycemia during travel Check feet daily for pressure sores For guidance re: YF vaccine, see Approach to Immunizations: Preparing Travelers with Severe Immune Compromise: Vaccine Considerations for Travelers with Severe Immune Compromise: Yellow Fever, in Sec. 3, Ch. 1, Immunocompromised Travelers
GASTROINTESTINAL DISORDERS (INCLUDING LIVER DISEASE)	Bowel obstruction GI bleed, active or recurrent Liver failure, uncompensated Post–major abdominal surgery: minimum 10–14 days, and improving, before travel Post–colonoscopy (uncomplicated): minimum 24 hours before travel Post–laparoscopic surgery: minimum 3–5 days, and improving, before travel	Emphasize safe food and water precautions For travelers with chronic liver disease, cirrhosis, or heavy alcohol use, advise against eating raw or undercooked shellfish, due to possible overwhelming *Vibrio vulnificus* sepsis Consider prescribing prophylactic antibiotics for TD	Influenza Pneumococcal Hepatitis A Hepatitis B	Increased colostomy output might occur during air travel Patients with cirrhosis and history of hepatopulmonary syndrome or portopulmonary hypertension might be at increased risk for clinical deterioration with travel to high elevations H2-receptor antagonists and PPIs increase susceptibility to TD Use mefloquine with caution in travelers with chronic liver disease
RENAL FAILURE & CHRONIC RENAL INSUFFICIENCY	None	Emphasize safe food and water precautions Plan for self-management of dehydration, which can worsen renal function Arrange dialysis abroad, if needed Adjust medications for CrCl	Influenza Pneumococcal Hepatitis B	Know pre-departure HIV, hepatitis C, and hepatitis B status Atovaquone-proguanil (Malarone) contraindicated when CrCl <30 mL/min AAKP and Global Dialysis (see Table 3-07) can help locate dialysis centers; check accreditation

(*continued*)

Table 3-08 Special considerations for travelers with chronic illnesses (continued)

CONDITION	CONTRAINDICATIONS TO & TIMING OF AIRLINE TRAVEL	PRETRAVEL RECOMMENDATIONS & CONSIDERATIONS	IMMUNIZATION CONSIDERATIONS	ADDITIONAL CONSIDERATIONS & GUIDANCE
				CKD can predispose patients to increased risk of DVTs and altitude sickness For guidance re: YF vaccine, see Approach to Immunizations: Preparing Travelers with Severe Immune Compromise: Vaccine Considerations for Travelers with Severe Immune Compromise: Yellow Fever, in Sec. 3, Ch. 1, Immunocompromised Travelers
RESPIRATORY TRACT DISORDERS	Asthma, severe or labile Bullous lung disease Lower respiratory tract infection, active Post–major chest surgery: minimum 10–14 days, and improving, before travel Post–PTX (spontaneous): minimum 7 days after full inflation before travel Post–PTX (traumatic): minimum 14 days after full inflation, before travel Pulmonary hypertension, severe Supplemental oxygen requirements: high, rapidly fluctuating, or increasing	Supplemental oxygen Discuss with airline need for other equipment on plane (e.g., nebulizer) Plan for self-management of exacerbations (including asthma, COPD) DVT precautions	Influenza Pneumococcal	Consider carrying a short course of antibiotics and steroids for exacerbations Consider taking an inhaler in a carry-on bag, even if not used routinely

Abbreviations: AAKP, American Association of Kidney Patients; AICD, automatic implantable cardioverter defibrillator; CABG, coronary artery bypass graft; CHF, congestive heart failure; CKD, chronic kidney disease; CNS, central nervous system; COPD, chronic obstructive pulmonary disease; COVID-19, coronavirus disease; CrCl, creatinine clearance; CVA, cerebrovascular accident; DVT, deep vein thrombosis; ECG, electrocardiogram; FSBG, fingerstick blood glucose; GI, gastrointestinal; Hgb, hemoglobin; HIV, human immunodeficiency virus; IGRA, interferon-γ release assay; INR, international normalized ratio; PNS, peripheral nervous system; PPIs, proton-pump inhibitors; PTX, pneumothorax; TD, travelers' diarrhea; TIA, transient ischemic attack; TNF, tumor necrosis factor; TST, tuberculin skin test; YF, yellow fever.

[a]There is a spectrum of airline travel–related risk that depends on the cardiovascular disorder, the defined risk group within the disorder, and the time since the acute event (if applicable). Evidence basis for recommendations is suboptimal, however.
[b]See Sec. 5, Part 3, Ch. 16, Malaria, for additional details.

BIBLIOGRAPHY

Aisporna C, Erickson-Hurt C. End-of-life travel: A bucket list desire for patients with life limiting illnesses. J Hospice Pall Nursing. 2019;21(5):397–403.

Furuto Y, Kawamura M, Namikawa A, Takahashi H, Shibuya Y. Health risk of travel for chronic kidney disease patients. J Res Med Sci. 2020;25:22.

Heng S, Hughes B, Hibbert M, Khasraw M, Lwin Z. Traveling with cancer: A guide for oncologists in the modern world. J Glob Oncol. 2019;5:1–10.

International Air Transport Association. Medical manual, 12th edition; July 2020. Available from: www.iata.org/en/publications/medical-manual.

Josephs LK, Coker RK, Thomas M; British Thoracic Society Air Travel Working Group. Managing patients with stable respiratory disease planning air travel: a primary care summary of the British Thoracic Society recommendations. Prim Care Respir J. 2013;22(2):234–8.

McCarthy AE, Burchard GD. The travelers with pre-existing disease. In: Keystone JS, Kozarsky PE, Connor BA, Nothdurft HD, Mendelson M, Leder K, editors. Travel medicine, 4th edition. Philadelphia: Saunders Elsevier; 2018. pp. 263–6.

Pinsker JE, Becker E, Mahnke CB, Ching M, Larson NS, Roy D. Extensive clinical experience: a simple guide to basal insulin adjustments for long-distance travel. J Diabetes Metab Disord. 2013;12(1):59.

Ringwald J, Strobel J, Eckstein R. Travel and oral anticoagulation. J Travel Med. 2009;16(4):276–83.

Smith D, Toff W, Joy M, Dowdall N, Johnston R, Clark L, et al. Fitness to fly for passengers with cardiovascular disease. Heart. 2010;96(Suppl_2):ii1–16.

US Department of Justice. Exemption from import or export requirements for personal medical use. Title 21 CFR §1301.26. 2004 Sep 14. Available from: www.deadiversion.usdoj.gov/fed_regs/rules/2004/fr0914.htm.

HIGHLY ALLERGIC TRAVELERS

Sue Ann McDevitt, Gail Rosselot

Allergies are the 6th leading cause of chronic illness in the United States, and >50 million Americans experience allergies each year. Food allergies affect 8%–11% of children and adults in the United States; other major allergen categories include dust, insect venom, latex rubber, medications, mold, pets, and pollen. Highly allergic travelers might experience severe allergic reactions that could interrupt or alter planned activities or require emergency medical care during travel. Pay special attention to travelers with a history of anaphylaxis (see Box 3-04).

Travelers with severe allergies face health and safety risks during their journeys, and international itineraries expose travelers to numerous possible allergy triggers. Comprehensive lists of transportation-related and country-specific triggers are not typically available, and language barriers, lack of 9-1-1–like emergency services, and unfamiliar environments and menu items can

BOX 3-04 Anaphylaxis: key points for travelers & health care providers

- Anaphylaxis is an acute, life-threatening systemic allergic reaction; it can have a wide range of clinical manifestations, including cardiac (heart), dermatologic (skin), gastrointestinal (digestive tract), and respiratory (lungs)
- Main risks for anaphylaxis in adults: medications and stinging insect venom
- Main risks for anaphylaxis in children and adolescents: foods and stinging insect venom
- Among patients with a history of severe allergic reactions, approximately 1 in 4 have never had a specialist consult
- Although the first-line medication for anaphylaxis is epinephrine, auto-injectors are available in only approximately 1 in 3 countries around the world
- The lifetime risk for anaphylaxis is 1%–5%; studies suggest increasing incidence

compound the risk. Any environmental or food allergy can affect the success or pleasure of a trip, but severe reactions can be trip-altering and life-threatening.

Help travelers reduce their chances of being exposed to allergy triggers and having a (severe) reaction by emphasizing proactive communication and providing pretravel services that include careful assessment and prevention counseling. Assist highly allergic travelers in creating a written emergency action plan, a critical element of their pretravel preparation. Even during the shortest office visit, confirm allergies and provide guidance to help travelers respond appropriately to severe reactions. Early recognition of anaphylaxis and prompt self-administration of epinephrine and other medications can be lifesaving.

PRETRAVEL ASSESSMENT

During the pretravel assessment, routinely ask travelers about vaccine and vaccine-component, medication, food, and environmental allergies. At each visit, inquire about all drugs, including prescribed, over-the-counter, herbal, recreational, and international brands. Patients' allergies can worsen or improve over time, and new allergies might develop. Check vaccine ingredients listed in the manufacturer's product insert to appropriately care for individuals with history of allergic reactions.

Asthma and food and insect venom allergies are as likely to occur among international travelers as they are among the general population. Review the nature and extent of any reported allergy and the traveler's experience with allergies and self-care management skills.

PREPARATION

Travelers with severe allergies might need extra pretravel preparation. Clinicians can provide customized self-care plans that include suggestions for extra travel medical kit items, travel medical insurance recommendations, country-specific information (where available), guidelines for communication about severe allergies, and referral to a specialist, if warranted (see Box 3-05).

BOX 3-05 Allergy self-care management plan: a checklist for travelers

- ☐ Identify allergy triggers and learn how to avoid them.
- ☐ If you have a history of anaphylaxis, see an allergy specialist before you travel.
- ☐ Research emergency services at your destination: where are they located, how to contact them.
- ☐ Anticipate and research dietary and environmental allergy triggers for airplanes, cruise ships, and trains.
- ☐ Ask about airline allergy policies in advance of travel; alert gate and onboard personnel about specific allergy triggers.
- ☐ Bring along allergy-safe food and snacks, if indicated.
- ☐ Bring several copies of a written emergency action plan for preventing and responding to reactions; keep a copy with you at all times. Consider having a copy translated into the destination language.
- ☐ Buy travel medical assistance insurance and confirm coverage for medical and emergency services overseas.
- ☐ Check your prescriptions, confirm expiration dates, and carry extra medical supplies of all self-care therapies (e.g., antihistamines, inhalers, prednisone) in your carry-on luggage; medically necessary liquids and medications in excess of Transportation Security Administration (TSA) limits are allowed.
- ☐ Epinephrine
  - ○ Keep your epinephrine auto-injector supply (2 or more) on your person, not in overhead bins.
  - ○ Never rely on an airline having epinephrine readily available.
  - ○ Recognize signs of a severe allergic reaction and know when to use medications and epinephrine auto-injectors; get additional training if needed.
  - ○ If you use epinephrine to self-treat an allergic reaction, you must go to an emergency room for evaluation and monitoring until you are fully stable.
- ☐ Share action plans with guides and traveling companions; never be too embarrassed or hesitant to alert others about a severe allergy.
- ☐ Wear a medical identification bracelet; carry a card or electronic equivalent listing all medical conditions and medications.

BOX 3-06 Food allergies: a checklist for travelers

- ☐ Ask about menu items, ingredients, and preparations; sauces are often a cause of reaction due to hidden ingredients.
- ☐ Bring along nonperishable food supply in case safe food cannot be located during travel.
- ☐ Carry "chef cards" (www.foodallergy.org/diningout) or equivalents (www.allergytranslation.com; www.selectwisely.com) in English and the languages of destination countries to communicate food allergies to all restaurant staff.
- ☐ Carry a supply of sanitary wipes to clean hands and wipe down tray tables and eating utensils.
- ☐ Consider staying in accommodations that provide small refrigerators or kitchens for self-catering.
- ☐ Dietary vigilance is critical; when in doubt, avoid a food item.
- ☐ European Union countries and some others mandate menu labeling for 8–14 different allergens (e.g., shellfish, soy, tree nuts, wheat).
- ☐ FARE's website (www.foodallergy.org) has food allergy guidelines for 13 countries.
- ☐ International travel raises the risk for trying foods that could contain allergy triggers; avoid "street food" and consider eating at chain restaurants where ingredients and food preparation are more standardized.
- ☐ Main food allergens: dairy products and milk; eggs; fish and shellfish; peanuts; sesame; soy; tree nuts; wheat.
- ☐ Research destinations for in-country allergy websites and "allergy aware" restaurants and grocery stores.
- ☐ When purchasing food during travel, read food labels carefully, and seek language assistance, if needed.

BOX 3-07 Airborne allergies: a checklist for travelers

- ☐ Review Box 3-05 (Allergy self-care management plan: a checklist for travelers).
- ☐ Consider packing pillow and mattress covers.
- ☐ Use a well-fitting face mask to minimize particulate matter exposure.
- ☐ Ensure easy cancellation policies with your host or property owner in advance; on arrival you might find your accommodations put you at increased risk for exposure to airborne allergens (e.g., tiled or wood flooring is preferable to carpeting to minimize dust allergen reactions).
- ☐ Identify and reserve smoke free (pet free) accommodations and restaurants when possible.
- ☐ If you have asthma, pack all equipment including spacers, nebulizers, and peak flow meters.
- ☐ Minimize outdoor activity when air quality is poor, or pollen count is very high.
- ☐ Research air quality and pollen counts at destinations.
  - ○ Air quality: www.waqi.info
  - ○ Pollen counts: https://patients.eaaci.org/worldwide-map-of-pollen-monitoring-stations/

BOX 3-08 Skin & contact allergies: a checklist for travelers

- ☐ Hiking boots and backpacks can have allergens or irritants in the manufacture or gluing process.
  - ○ Try out equipment before departure to see if you have a reaction.
- ☐ Test any product applied to the skin (e.g., insecticides, repellents, and sunscreens) before travel.
  - ○ Try on all clothing items pretreated with these products to see if you have a reaction.

Suggest travelers view information from organizations with resources that promote safe international travel for people with allergies, such as the American Academy of Allergy, Asthma, and Immunology (AAAAI; www.aaaai.org), Asthma and Allergy Foundation of America (AAFA; www.aafa.org/page/traveling-with-asthma-allergies.aspx), and the Food Allergy and Research Foundation (FARE; www.foodallergy.org). These organizations publish websites, educational materials, template allergy action plans, and communication tools that can help travelers reduce their chances of exposure to allergic triggers.

Encourage travelers with severe allergies to seek pretravel care well in advance of departure. In particular, consider providing a specialist referral to any traveler with a history of idiopathic anaphylaxis, new severe allergies, and recent or recurrent severe allergic reactions; help travelers understand that a specialist might generate additional recommendations that could delay or reroute their travel.

BIBLIOGRAPHY

American Academy of Allergy, Asthma & Immunology. School tools: anaphylaxis and food allergy resources for professionals. Available from: www.aaaai.org/Tools-for-the-Public/School-Tools.

Cardona V, Ansotegui IJ, Ebisawa M, El-Gamal Y, Fernandez Rivas M, Fineman S, et al. World Allergy Organization anaphylaxis guidance 2020. World Allergy Organ J. 2020;13(10):100472.

Food Allergy Research & Education (FARE). Food allergy and anaphylaxis plan. Available from: www.foodallergy.org/living-food-allergies/food-allergy-essentials/food-allergy-anaphylaxis-emergency-care-plan.

Shaker MS, Wallace DV, Golden DBK, Oppenheimer J, Bernstein JA, Campbell RL, et al. Anaphylaxis—a 2020 practice parameter update, systematic review, and Grading of Recommendations, Assessment, Development and Evaluation (GRADE) analysis. J Allergy Clin Immunol. 2020;145:1082–1123.

Wang J. Sicherer SH; American Academy of Pediatrics, Section on Allergy and Immunology. Guidance on completing a written allergy and anaphylaxis emergency plan. Pediatrics. 2017;139(3):e20164005.

SUBSTANCE USE & SUBSTANCE USE DISORDERS

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In 2020, 40.3 million people aged 12 or older in the United States (14.5% of this population) reportedly had a substance use disorder (SUD) in the past year (www.samhsa.gov/data/report/2020-nsduh-annual-national-report). The prevalence of SUDs underlines the need to ensure that people who use drugs, those experiencing SUD, and those recovering from SUD have access to information that can reduce their risk of harms (e.g., overdose) and support recovery efforts. Travel, for business or pleasure, can exacerbate SUDs, cause clinical deterioration in people with a chemical dependence disorder, and impede participation in recovery support systems (e.g., 12-step groups) that help people maintain abstinence from substance use.

Travelers should be aware of policies and risks associated with substance use in nations where they are traveling. Substances that are legal in the United States, including medications used to treat SUDs, might be illegal in other countries. In addition, travelers could encounter substances in other countries that are less common in the United States, or substances that are more potent or adulterated in unexpected ways. Finally, traveling to places where substance and alcohol use regulations and policies differ from the traveler's home (e.g., countries or states where cannabis use

is legal or countries where the legal drinking age is lower than in the United States) could provide opportunities for people who otherwise do not use substances, including alcohol, to use them; such use could be associated with negative health consequences and other risky behaviors.

Most psychoactive products can complicate the physiologic adjustments associated with international travel (e.g., adaptation to different climates, elevations, time zones). Alcohol and drug use also can cause deterioration of clinical conditions during travel and can precipitate other medical problems associated with travel, including diarrheal diseases, heat-related illness, and motion sickness. Furthermore, alcohol and drugs are major contributors to unintentional injury, near-drowning, violence, arrest or detention, repatriation, and death while traveling.

ALCOHOL

Some people identify travel as an opportunity for increased alcohol consumption. Discuss with them that adults of legal drinking age can choose not to drink, or to drink in moderation by limiting intake to ≤2 drinks in a day for men or ≤1 drink in a day for women. Drinking less alcohol is better for health than drinking more, and individuals who do not drink should not start. People of legal drinking age who should not drink at all include those with certain medical conditions, those taking medications that can interact with alcohol, and those unable to control the amount they drink or who are recovering from alcohol use disorder. See the Dietary Guidelines for Americans (www.cdc.gov/alcohol/fact-sheets/moderate-drinking.htm) for more information.

On its own, excessive alcohol use can produce undesirable effects for travelers (see Table 3-09). In addition, even small amounts of alcohol can interact with medications specifically prescribed for travel, creating adverse reactions leading to unwanted visits to unfamiliar health care providers. Alert travelers about the risks associated with drinking in other countries. In many places, alcohol concentrations in beverages exceed those found in the United States. In some countries, alcohol use is illegal in certain settings; policies can vary. Remind all travelers not to drink and drive; each country sets its own legal maximum blood alcohol concentration; in some countries, the level is below that in the United States.

Excessive Alcohol Use

Excessive alcohol use includes binge drinking, heavy drinking, and any drinking by pregnant women or people younger than the legal drinking age. Binge drinking, the most common form of excessive drinking, is defined as consuming 4 or more drinks during a single occasion (for women), and 5 or more drinks during a single occasion (for men). Although most people who binge drink do not have a severe alcohol use disorder, binge

Table 3-09 Adverse clinical effects associated with alcohol consumption during international travel

DURING TRAVEL	Barotrauma Dehydration Hypoxemia Intoxication Motion sickness Sedation
AT THE DESTINATION	Unintentional injury or death (e.g., dive-related injuries, drowning, falls, motor vehicle crashes) Acclimatization (including heat exhaustion and heat stroke, hypothermia, and frostbite) Altitude Illness / Acute Mountain Sickness Gastrointestinal disturbances (including travelers' diarrhea) Jet lag

drinking is a harmful risk behavior associated with serious injuries and multiple diseases.

Excessive alcohol use, including binge drinking, is associated with short-term (e.g., alcohol poisoning, overdoses, injuries, violence) and long-term (e.g., liver disease, cancer, heart disease, hypertension) health conditions. Excessive alcohol use increases a person's chances of engaging in risky sexual activity including unprotected sex, sex with multiple partners, or sex with a partner at risk for sexually transmitted infections (STIs). It is also associated with unintentional injuries (e.g., motor vehicle crashes, falls, burns, alcohol poisoning); violence (e.g., homicide, suicide, intimate partner violence, sexual assault); and STIs.

Tips for drinking less include setting limits, counting drinks, managing triggers (certain people, places, or activities might tempt the traveler to drink more than planned), and being around people who support moderation in or abstinence from drinking. For more details on excessive alcohol use and its effects on health, see www.cdc.gov/alcohol/index.htm.

Alcohol Use Disorder

Excessive drinking is also associated with an increased risk for alcohol use disorder, a chronic medical condition (www.niaaa.nih.gov/publications/brochures-and-fact-sheets/understanding-alcohol-use-disorder). Options and strategies for people with alcohol use disorder to avoid alcohol during travel are presented in Box 3-09; Alcoholics Anonymous (www.aa.org) provides information on meetings occurring domestically and internationally. Suggest travelers use the acronym HALT (Hungry, Angry, Lonely, Tired) to remind them

BOX 3-09 Strategies for people with alcohol use disorder to avoid alcohol during travel

BEFORE LEAVING

Connect or reconnect with

- A counselor/sponsor/mentor
- Support groups (e.g., Alcoholics Anonymous, Narcotics Anonymous)

Select

- Destinations and season wisely (e.g., avoid gatherings associated with alcohol, such as Octoberfest festivals)
- Direct flights to avoid layovers and long travel times
- Travel agencies/resorts that specialize in alcohol-free travel

Consider

- How to avoid people and places that trigger cravings and return to use
- Traveling with a trusted friend

Plan ahead

- Call ahead to have mini bar/alcohol removed from room
- Discuss disulfiram with your healthcare provider
- Pack favorite audio materials, books, journals
- Research support groups at destination (www.aa.org)
- Research other potential treatment/support services

WHILE AWAY

Healthy behaviors

- Attend support group meetings (as appropriate) at destination
- For business meetings/events: "be discreet, meet and greet, then retreat"
- Participate in spa/gym/athletic activities
- Remain connected with counselor/sponsor/mentor and home network
- Request that the mini bar/alcohol be removed from the room if not already done so
- Stick to your routine; avoid blocks of idle time; meditate
- Use technology (e.g., Zoom, chat rooms) whenever in-person support group meeting attendance is not possible

Avoid

- Alcohol (e.g., bourbon, whiskey, wine) tasting events
- Happy Hours and open bars; use caution when attending "team building" events
- Low alcohol and "alcohol-free" beer
- People/places that could trigger cravings
- Wine-pairing suppers or events
- Winery or microbrewery tours

of the triggers for drinking and the need to take appropriate avoidance measures.

Pharmacologic options are available to assist in treating alcohol use disorder, including acamprosate, disulfiram, and naltrexone. Advise travelers taking disulfiram to avoid "alcohol-free" beers because these products can contain ≤0.5% alcohol, enough to produce a reaction. Moreover, it is inadvisable to initiate first-time pharmacologic intervention at the onset of an international trip.

CANNABIS

The cannabis plant contains more than 100 compounds (or cannabinoids). Cannabis (marijuana, weed, pot, dope) refers to the dried flowers, leaves, stems, and seeds of the cannabis plant, as well as concentrates, edibles, extracts, tinctures, vape cartridges, and other products that contain Δ-9-tetrahydrocannabinol, the main psychoactive ingredient of the plant. Because cannabinoid use policies vary from country to country, travelers should review the policies and regulations around transport, possession, and use of cannabis or cannabinoids in the countries to which they are traveling and passing through. In many countries, possession and use of cannabis can result in severe criminal penalties, including imprisonment.

Cannabis has been legalized in some US states for medical or nonmedical adult use, and although its use and possession at some airports might be allowed, cannabis remains categorized as a Schedule I substance (www.dea.gov/drug-information/drug-scheduling) in the United States and is illegal at the federal level. Cruise lines follow federal law; federal scheduling of cannabis as a Schedule I substance also prohibits use and possession on cruise ships.

OPIOIDS

According to the National Survey on Drug Use and Health (https://nsduhweb.rti.org), in 2020, 9.5 million people aged >12 years reported misusing prescription opioids or using heroin within the past 12 months, and 2.7 million reported having an opioid use disorder (OUD). OUD is not uncommon in the United States, and travel medicine providers likely will encounter patients experiencing, or in recovery for, this condition. Preparing travelers with OUD to travel internationally requires additional planning.

Illicit opioid use and misuse of prescription opioids are factors that increase risk for overdose. Evidence-based strategies for reducing the risk for overdose associated with illicit opioid use include use of fentanyl test strips (FTS) and access to naloxone. FTS are used to determine whether fentanyl has been mixed with drugs; naloxone can reverse an overdose from opioids, including fentanyl, heroin, and prescription opioid medications.

Medications for Treating Opioid Use Disorder

Medications are available to effectively prevent overdose, treat OUD, and sustain recovery; these medications might be restricted or prohibited in other countries, however. Examples of medications used to treat OUD include buprenorphine and methadone, which act as opioid agonists. These medications reduce cravings and withdrawal symptoms and block the effects of other opioids (e.g., heroin). The opioid antagonist naltrexone works by blocking the effects of opioids.

The Transportation Security Administration (TSA), US Department of State, and US Centers for Disease Control and Prevention (CDC) provide guidance for traveling with prescription medications, including medications used to treat substance use disorders. Travelers should check with the US embassy (www.usembassy.gov) located in the country they plan to visit or travel through to make certain their medications are allowed in that country and determine whether they need any documentation to bring medications. The International Narcotics Control Board provides information on country regulations for travelers carrying medications containing controlled substances at www.incb.org/incb/en/travellers/country-regulations.html.

Travelers should carry all medications in their original labeled container with a copy of the prescription printed on the container and a statement from the medical director of the clinic or prescribing physician on letterhead detailing the care being provided. The name listed on prescriptions, medication bottles, and letters from health care providers should match the name on the

traveler's passport. Although medications can be packed in carry-on or checked baggage, traveling with prescriptions in carry-on luggage can help to ensure ready access to medications in an emergency or if checked luggage is lost.

METHADONE

In the United States, methadone treatment programs are strictly regulated by the federal government, and methadone treatment for OUD can only be dispensed by federally certified opioid treatment programs (OTPs); regulations include prerequisites to be eligible for take-home medication. Most methadone treatment programs dispense the medication daily in person, and a patient must complete continuous treatment in an OTP for >12 months before being permitted to take home >1 week's supply of methadone. A maximum of 1 month's (31 days) supply of methadone can be provided to patients who have completed 2 years of continuous treatment.

Recovery Support Services

Encourage patients with OUD to review information about recovery support services in other countries, such as information provided on the Narcotics Anonymous website (www.na.org). In addition, global advocacy and support groups are available for people taking methadone and other treatments for OUD. For instance, the German organization INDRO e.V. operates the Coordinating and Information Resource Center for International Travel by Patients Receiving Methadone and other Substitution Treatments for Opiate Addiction (https://indro-online.de/en/the-coordinating-and-information-resource-center-for-international-travel) and publishes International Travel Regulations for Patients Participating in Drug Substitution Treatment (https://indro-online.de/en/travel-regulations-for-patients-participating-in-drug-substitution-treatment) and the Methadone Worldwide Travel Guide (https://indro-online.de/en/methadone-worldwide-travel-guide).

SUBSTANCE USE DISORDER TREATMENT

A subtype of "medical tourism" (see Sec. 6, Ch. 4, Medical Tourism) involves travel to another country for SUD treatment and rehabilitation care ("rehab tourism"). Box 3-10 lists some pros and cons of tourism for substance use disorder treatment. Travelers exploring this option might be seeking a greater range of treatment options at less expense than what is available domestically.

Before a traveler selects an international program for SUD treatment, encourage them to review information that can help them better understand proposed treatments. Evidence-based guidance is available from the Substance Abuse and Mental Health Services Administration (www.samhsa.gov/medication-assisted-treatment;

BOX 3-10 Pros & cons of international substance use disorder treatment

PROS

- Treatment and accommodations might be more affordable
- Privacy and seclusion might better afford anonymity
- Separation from triggers, stressors, sources of drugs, friends/family/acquaintances not supportive of recovery
- Potentially wider range of treatment alternatives
- Combining vacation with treatment

CONS

- Difficult for family to visit or have an active role in treatment process
- Difficult to arrange follow-up care; might be unable to liaise with local (at-home) support systems and services
- Language or communication challenges
- Differences in customs, attitudes, treatment plans
- Potential issues involving payment options, coverage, and reimbursement with standard medical insurance; not covered by travel health insurance
- Uncertainty about treatment modalities, quality of care, success rates

www.samhsa.gov/medication-assisted-treatment/medications-counseling-related-conditions/co-occurring-disorders; www.samhsa.gov/resource/ebp/treatment-stimulant-use-disorders) and CDC (www.cdc.gov/drugoverdose/featured-topics/evidence-based-strategies.html).

BIBLIOGRAPHY

Bergman BG, Hoeppner BB, Nelson LM, Slaymaker V, Kelly JF. The effects of continuing care on emerging adult outcomes following residential addiction treatment. Drug Alcohol Depend. 2015;153:207–14.

Centers for Disease Control and Prevention (CDC). Vital signs: overdoses of prescription opioid pain relievers—United States, 1999–2008. MMWR MorbMortal Wkly Rep. 2011;60(43):1487–92.

Centers for Disease Control and Prevention. Recovery is possible: treatment for opioid addiction. Available from: www.cdc.gov/drugoverdose/featured-topics/treatment-recovery.html.

Centers for Disease Control and Prevention. Traveling abroad with medicine. Available from: https://wwwnc.cdc.gov/travel/page/travel-abroad-with-medicine.

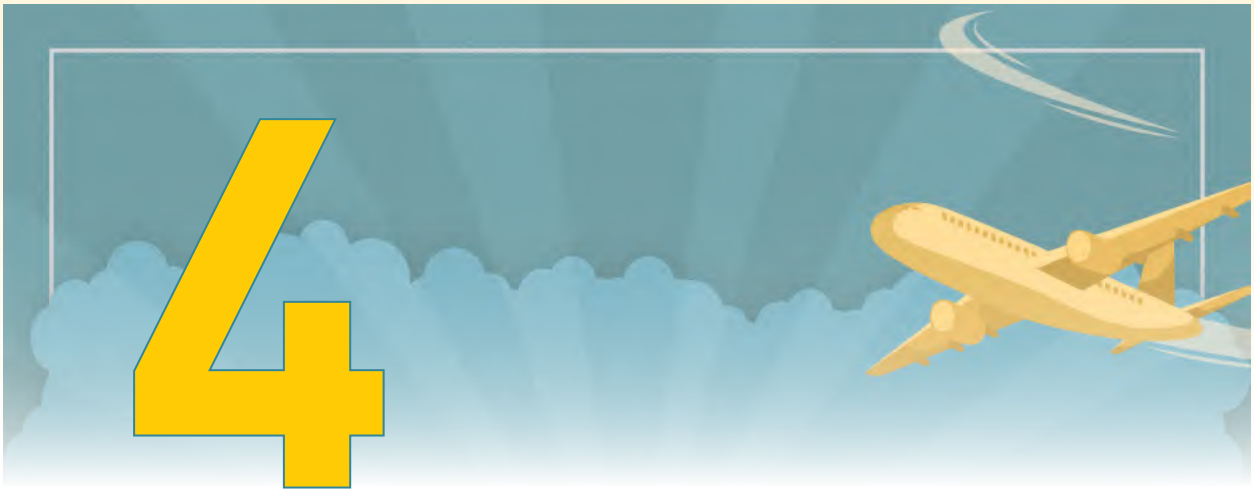
Paz A, Sadetzki S, Potasman I. High rates of substance abuse among long-term travelers to the tropics: an interventional study. J Travel Med. 2004;11(2):75–81.

Rundle AG, Revenson TA, Friedman M. Business travel and behavioral and mental health. J Occup Environ Med. 2018;60(7):612–6.

Substance Abuse and Mental Health Services Administration. Federal guidelines for opioid treatment programs. HHS publication no. (SMA) PEP15-FEDGUIDEOTP. Rockville, MD: The Administration; 2015. Available from: https://store.samhsa.gov/sites/default/files/d7/priv/pep15-fedguideotp.pdf.

Transportation Service Administration. Travel tips: Can you pack your meds in a pill case and more questions answered. Available from: www.tsa.gov/travel/travel-tips/can-you-pack-your-meds-pill-case-and-more-questions-answered.

Wackernah RC, Minnick MJ, Clapp P. Alcohol use disorder: pathophysiology, effects, and pharmacologic options for treatment. Subst Abuse Rehabil. 2014;23(5):1–12.



4 Environmental Hazards & Risks

SUN EXPOSURE

Karolyn Wanat, David Fivenson, Scott Norton

When international travelers engage in outdoor activities, they might be exposed to more ultraviolet (UV) radiation (UVR) than they are accustomed to, particularly if travel takes them to sunnier locations, lower latitudes, or higher elevations. Even winter activities (e.g., snow skiing) can result in significant UVR exposure. Short bursts of high-intensity UVR (e.g., infrequent beach vacations), as well as frequent, prolonged, cumulative UVR exposure can cause acute effects (e.g., sunburn and phototoxic medication reactions) and delayed effects from chronic exposure (e.g., sun damage, premature aging, skin cancers).

RISK FACTORS

Time of year, time of day, and location influence a traveler's UVR exposure. Most UVR reaches the earth's surface during summer months. Ultraviolet B (UVB), which is more carcinogenic than ultraviolet A (UVA), is most intense from 10 a.m.–4 p.m. at higher elevations and in locations closer to the equator. Snow and sand reflect UVR, thereby increasing UVB exposure. Although UVA is less carcinogenic than UVB, UVA occurs at high intensity throughout daylight hours. UVA causes more acute photosensitivity reactions than UVB, and it contributes more to premature aging.

Ultraviolet Index

The US National Weather Service prepares a daily Ultraviolet Index (UVI) for most zip codes. The UVI is calculated by a computer model that couples solar energy delivered at ground level with the ozone forecast and adjusts for elevation, atmospheric aerosol properties, and cloud conditions. The globally accepted UVI scale ranges from

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0 (at night or under a smoke-filled sky) to 16 (at high elevation in the tropics with no cloud cover). Higher UVIs indicate greater risks for skin- and eye-damaging UVR.

Daily UVIs for US locations are available at www.weather.gov/rah/uv. Global data for many sites outside the United States are available at the WHO website, www.who.int/news-room/q-a-detail/radiation-the-ultraviolet-(uv)-index.

Underlying Medical Conditions

People with certain medical conditions are at increased risk for adverse effects of UV exposure. Solid-organ transplant recipients, for example, are at much greater risk for UVB-induced skin cancers. People with autoimmune connective tissue diseases (e.g., systemic lupus erythematosus) exhibit heightened photosensitivity. Counsel these patients on how to protect themselves during hours of maximal exposure.

Photosensitizing Medications

Many medications, including several prescribed specifically for travelers, can lead to photosensitivity reactions. Examples include:

Antibiotics, including doxycycline (and other tetracyclines to a lesser degree), fluoroquinolones, sulfonamides.

Many types of cancer therapies (e.g., chemotherapeutic agents, radiation therapy, some immunomodulators) can be sun sensitizers during treatment, and effects can linger even after completion of therapy.

Nonsteroidal anti-inflammatory drugs (NSAIDs), especially ibuprofen, ketoprofen, naproxen, piroxicam.

Other common medications (e.g., furosemide, methotrexate, sulfonylureas, thiazide diuretics, retinoids).

CONSEQUENCES

Sunburn

Sunburn is a common and self-limited condition caused by UVA or UVB. Clinical features vary from mild pink to painful red skin with swelling and blistering on exposed surfaces. Systemic symptoms can include headache, fever, chills, nausea, vomiting, and muscle aches. Sunburn is preventable and travelers should not regard it as an inevitable part of vacation.

Sunburn management consists of symptomatic pain relief. People rarely notice they are developing a sunburn while the burn is occurring. When discomfort begins, people can take cool baths or apply wet compresses and bland topical emollients (e.g., petrolatum, zinc oxide). Refrigerating topical emollients before application can provide added relief. Aloe vera commonly is used as a sunburn remedy, but studies regarding its benefit are equivocal.

Intact blisters should not be ruptured intentionally. Topical corticosteroids (e.g., hydrocortisone 1% cream or ointment) or diclofenac gel can decrease pain and inflammation. Sunburn patients typically benefit from rest in a cool setting, extra fluids, and oral pain relievers (e.g., acetaminophen, ibuprofen, naproxen). Systemic steroids do not improve symptoms or hasten recovery.

For severe blistering cases, clinicians might need to hospitalize patients for fluid replacement (oral or intravenous) and pain control and treat them as they would burn patients, maintaining clean skin by gentle cleansing and treatment with emollients. Tense or painful blisters can be sterilely drained, but the blister roof should remain intact to serve as a sterile dressing.

Sun Damage & Skin Cancer

High-intensity or chronic exposure to UVR (particularly UVA) causes permanent loss of skin elasticity, wrinkling, and solar lentigines (brown macules with irregular borders), especially in people with fair skin. Avoiding sun overexposure and preventing sunburn are the best ways to avoid these skin changes.

The World Health Organization (WHO) characterizes UVR as a carcinogen with the potential to induce skin cancers via DNA damage. In addition, skin cancers are the most common malignancies in the United States, and basal and squamous cell carcinomas (BCCs and SCCs) are linked closely to UV exposure. BCCs typically appear as pearly, red papules that might bleed, ulcerate, or grow into nodules; they appear often on sun-exposed areas. BCCs rarely metastasize and are generally cured with excision or other local treatments.

SCCs present as scaling or bleeding papules or plaques on sun-exposed areas. Advanced or long-standing SCCs are 10× more likely to metastasize than BCCs. Solid-organ transplant patients who are on immunosuppressive therapy and patients with chronic lymphocytic leukemia are at increased risk for SCCs.

Melanoma is the most serious of the UV-associated skin cancers; it is also the least common, but its incidence is increasing among most populations. Risk factors for melanoma include fair skin, genetic susceptibility, and a history of blistering sunburns before the age of 18. Melanomas have a variety of clinical presentations, the most common of which is an irregularly bordered, darkly pigmented flat or raised spot on the skin that changes in size, shape, or both over time. For clinical suspicion for melanoma, clinicians should refer the patient for prompt evaluation and possible biopsy. Of the skin cancers, melanomas have the greatest morbidity and mortality; in 2018, the latest year for which incidence data are available, ≈84,000 new cases of melanoma of the skin were reported in the United States, and ≈8,200 people died from this cancer. Early detection and treatment (simple excision with margins) lead to complete recovery in most cases. Depending on the tumor stage, patients might need additional surgeries, evaluations, treatment with chemotherapeutic or biological agents, and regular monitoring.

While some reports describe an association between chronic and cumulative sun exposure and SCC, and intermittent intense sun exposure and blistering sunburns with BCC and melanoma, the evidence for this in the literature is mixed.

Other Photosensitivity Disorders

Increased exposure to sunlight, particularly UVA, can exacerbate existing skin conditions and can unmask photosensitivity disorders, such as autoimmune connective tissue diseases (e.g., dermatomyositis or systemic lupus erythematosus), phototoxic medication reactions, polymorphous light eruption, porphyrias, and solar urticaria. A person experiencing prolonged or severe symptoms after sun exposure (e.g., arthralgias, fever, pruritus, swelling) should seek medical evaluation.

PHOTO-ONYCHOLYSIS

Photo-onycholysis is a separation or lifting of the nail plate from the nail bed in people taking an oral photosensitizing agent, usually a medication, in association with intense sun exposure. The most common setting is someone taking doxycycline for malaria prophylaxis during a trip to a tropical location.

PHYTOPHOTODERMATITIS

Phytophotodermatitis is a noninfectious condition that results from action of UVA radiation on naturally occurring photosensitizing compounds, furocoumarins, that occur in several plant families. In the tropics, the most common source is the photosensitizing juice of certain types of limes, often called Persian, wild, or key limes; in northern temperate regions, the most common source is giant hogweed (*Heracleum mentagazzium*). The interaction of UV light and the furocoumarins causes an exaggerated sunburn that creates a painful line of blisters where the juice was on the skin, followed by linear, brown, hyperpigmented patches that take weeks or months to resolve.

PREVENTION

Travelers should prepare and plan to prevent sun overexposure. To encourage safe sun behaviors, clinicians can remind travelers that UVB radiation is highest during midday, that UV exposure still occurs in cooler weather and on overcast days, and that UVR increases with travel to lower latitudes (closer to the equator) and higher elevations.

Sun Avoidance

If possible, travelers can decrease UV exposure by avoiding direct sun during peak hours, 10 a.m. to 4 p.m. Travelers can seek shade under trees, umbrellas, or other structures to reduce UV exposure; UV rays can still reflect off surfaces, however, including snow and sand. Studies show that concomitantly using shade and sunscreen is more effective than reliance on a single method to protect people from excessive UVR.

Sunscreens

Sunscreens are topical preparations containing substances that reflect or absorb light in the

BOX 4-01 Choosing a sunscreen

The most effective sunscreens are broad-spectrum, combining agents capable of filtering (either by absorbing or reflecting) both ultraviolet A and B (UVA and UVB) radiation.

The American Academy of Dermatology Practice Safe Sun guidelines (Box 4-05) recommend using products with a sun protection factor (SPF) ≥30.

Current labeling guidelines adopted by the US Food and Drug Administration (FDA) in 2010 indicate that broad-spectrum sunscreen products with an SPF ≥15 may state: If used as directed with other sun-protection measures, [this product] decreases the risk of skin cancer and early skin aging caused by the sun.

The same labeling guidelines do not permit manufacturers to claim that products are waterproof or sweatproof; sunscreens may be labeled "water resistant" for up to either 40 or 80 minutes.

CHOOSING A SUNSCREEN OUTSIDE THE UNITED STATES

Sunscreens sold outside the United States contain a much wider variety of UV filters.

The UV filters listed below have lower reported environmental toxicity, but none have yet come up for review before the FDA.

The FDA process for UV filter approval is under review and will most likely begin with systematic human toxicity testing of the currently allowed UV filters before agents in use elsewhere in the world are included.

In Europe, Japan, and Australia, commonly available UV filters in sunscreens include the following:

Mexoryl XL (drometrizole trisiloxane)
Neo Heliopan AP (bisdisulizole disodium)
Neo Heliopan E1000 (amiloxate)
Parsol 5000 (enzacamene, 4-MBC)
Tinsorb A2B (tris-biphenyl triazine)
Tinsorb M (bisoctrizole)
Tinsorb S (bemotrizinol)
Tinsorb S Aqua (polysilicone-15)
Uvasorb HEB (iscotrizinol)
Uvinul A Plus (diethylamino, hydroxybenzoyl hexyl benzoate)
Uvinul T 150 (octyl triazone)

In South America, commonly available UV filters in sunscreens include the following:

Mexoryl SL (benzylidene camphor sulfonic acid)
Mexoryl SO (camphor benzalkonium)
Mexoryl SW (polyacryamidomethylbenzylidene camphor)
PEG-25 PABA (ethoxylated ethyl-4-aminobenzoate)

UV wavelengths and reduce the amount of UVR that reaches the skin. There are two classes of active ingredients, known as UV filters, in sunscreen products: chemical (sometimes referred to as organic) and physical (sometimes referred to as mineral or inorganic). Sunscreen products can contain chemical or physical filters, or both, and might include >1 of each type. FDA regulates sunscreens and their filtering agents in the United States, but some other countries permit the use of chemical filtering agents not approved by the FDA. See Box 4-01 for filtering agents in sunscreen products from different countries.

CHOOSING A SUNSCREEN

Travelers can use many criteria when selecting a sunscreen, but in practical terms, the best sunscreens are those that people choose to use consistently. See Box 4-01 for additional details on choosing sunscreens.

SUN PROTECTION FACTOR

The US Food and Drug Administration (FDA) uses a strict protocol to determine a product's sun protection factor (SPF): how much UVB radiation is required to cause a sunburn on skin protected by topical sunscreen products versus the amount of UVB required to cause a sunburn on unprotected skin (see Box 4-02). SPF measures protection from UVB only, not UVA. Most people know that the higher the SPF, the greater degree of protection from UVB and from sunburn.

In theory, an SPF of 30 means that only 1/30th of the UVB reaches the skin—or that a person can remain in the sun 30× as long—when the sunscreen is applied. To achieve the desired SPF, however, a person must apply an adequate amount of sunscreen, avoid rinsing or rubbing or sweating it off, and reapply it every 2 hours. From a mathematical perspective, sunscreens rated as SPF 30 block 97% of UVB, SPF 50 block 98%, and SPF 100

BOX 4-02 US Food and Drug Administration (FDA) sunscreen definitions

SUN PROTECTION FACTOR (SPF)

A measure of how much solar energy (UVB radiation) is required to produce sunburn on protected skin (i.e., in the presence of sunscreen) relative to the amount of solar energy required to produce sunburn on unprotected skin. As the SPF value increases, sunburn protection increases.

BROAD SPECTRUM

The FDA permits a sunscreen to be labeled as "broad spectrum" if it provides adequate protection from both UVA and UVB radiation.

WATER RESISTANT

Claims of water resistance on a sunscreen's label must indicate whether the sunscreen remains effective for 40 minutes or 80 minutes while swimming or sweating, based on standard testing. Sunscreens that do not meet this standard must include a direction instructing consumers to use a water-resistant sunscreen when swimming or sweating.

The FDA does not define, nor does it use, the following terms: baby-safe, reef-safe, anti-aging, sport, kid-friendly, dermatologist-tested, all natural, sweat-proof, or waterproof.

block 99%. The FDA discourages claims of SPF >50 on a product's label because it is meaningless.

CHEMICAL (ORGANIC) UV FILTERS

Sunscreens with chemical UV filters are absorbed into the skin and work like a sponge to absorb the sun's rays. Chemical UV filters currently approved for use in the United States include avobenzone, cinoxate, ecamsule, homosalate, octinoxate, octisalate, octocrylene, and oxybenzone. Less commonly used filters include dioxybenzone, ensulizole, meradimate, padimate O, and sulisobenzone. Products containing chemical UV filters can be easier to apply and are less likely to leave a white residue than physical UV filters. People with naturally dark skin might be averse to using certain sunscreens because they leave a whitish appearance or ashy look; however, people with dark skin also need protection against the short- and long-term effects of UVR described above. Box 4-03 provides information on some possible

BOX 4-03 Risks associated with sunscreen use: human

CHEMICAL (ORGANIC) ULTRAVIOLET (UV) FILTERS

Contact dermatitis, both allergic and irritant.

Sun sensitivity (associated with avobenzone, cinoxate, octocrylene).

Several studies show that chemical UV filtering agents can be absorbed across the skin and reach detectable levels in human blood and tissues. Chemical UV filters have been widely detected in urine, blood, and breast milk. Many of these compounds are being studied as possible endocrine disruptors, which means they might interfere with hormones doing their normal bodily functions. The effects, if any, that chemical UV filters have on hormones like thyroid, estrogen, and testosterone in humans, marine or aquatic organisms, or ecosystems are unclear. In experimental animal studies, where much higher amounts of UV filter have been used, reports of significant changes in thyroid and sex hormones and potential effects on fertility and fetal development have been reported.

Recent reports of potential carcinogenicity of sunscreens were the result of poor manufacturing practices that allowed contaminants (e.g., benzene) to taint the products and were not due to intrinsic carcinogenicity of the sunscreen agents.

PHYSICAL (INORGANIC) UV FILTERS

Rarely, cause skin irritation.

People should avoid using as sprays, because inhaling metallic nanoparticles can be harmful to the lungs.

BOX 4-04 Risks associated with sunscreen use: environmental

Among the most concerning reports about sunscreens is that ultraviolet (UV) filters might harm marine ecosystems. This is a complex and unresolved point, because coral is damaged by a variety of environmental changes, especially cycles of increased ocean water temperatures. Laboratory evidence suggests that high concentrations of certain UV filters damage the symbiotic algae, known as zooxanthellae, that live within the live tips of coral, causing a loss of color known as "coral bleaching." Repeated cycles of bleaching can kill living coral. Many other marine and aquatic organisms are also being studied for possible effects caused by chemical sunscreens. Overall, less evidence shows that physical UV filters (zinc oxide and titanium dioxide) pose toxicity to humans, animals, or the environment.

Clinicians should suggest that travelers choose sunscreens that are the least harmful for marine ecosystems. Several states and nations have legislation prohibiting the use of chemical (organic) sunscreens in favor of products containing physical (inorganic) UV filters, zinc oxide or titanium oxide. Many ocean resort destinations have banned some of the chemical UV filters; these include Hawaii, the US Virgin Islands, Palau, Bonaire, Aruba, Mexico, Brazil, and numerous locations in the European Union. Travelers should check regulations in effect at their destination prior to departure.

When selecting sunscreens that contain chemical UV filters, travelers should choose products that contain less than 3% avobenzone, 3% cinoxate, 3% ecamsule, 10% homosalate, 5% octinoxate, 5% octisalate, 5% octocrylene, or 5% oxybenzone.

Good sources of independent information for consumers and travelers on ever-changing sunscreen information include Consumer Reports (www.consumerreports.org) and the Environmental Working Group (www.ewg.org), both of which regularly review and rate sunscreen products and their components.

The National Oceanographic and Atmospheric Administration (NOAA) provides a useful infographic on this topic (https://oceanservice.noaa.gov/news/sunscreen-corals.html).

health risks associated with use of chemical UV filters.

PHYSICAL (INORGANIC) UV FILTERS

Physical, or inorganic, UV filters reflect both UVA and UVB from the skin's surface. Worldwide, only 2 products are used as physical filters: zinc oxide and titanium dioxide. These metallic oxides are pulverized into microparticle or nanoparticle size, then mixed with a vehicle or emollient that permits them to be applied smoothly to the skin. Sunscreens might contain none, one, or both agents.

Physical sunscreens pose very little risk of causing allergic or irritant contact dermatitis (see Box 4-03). They can, however, leave a thin, white film or cast on the skin. Nevertheless, current products are cosmetically more acceptable than the older thick, opaque pastes.

Travelers also might opt for or be required to use sunscreens with physical UV filters due to reported adverse environmental effects of chemical UV filter–containing sunscreens (see Box 4-04). Some locations that require physical UV filters include Aruba, Bonaire, parts of Mexico, Palau, and the US Virgin Islands. In 2018, Hawaii passed a law banning sunscreens containing octinoxate and oxybenzone in response to evidence of their toxicity to coral marine life.

SUNSCREENS FOR CHILDREN

Parents or guardians should protect children <6 months old from direct sun exposure, opt for shade, and dress children in lightweight long-sleeved shirts, long pants, wide-brimmed hats, and sunglasses. They can protect infants by using covered strollers or perambulators, umbrellas or parasols, and hats, rather than by applying sunscreen.

For children >6 months of age, parents or guardians should use sunscreens with physical UV filters (titanium dioxide or zinc oxide) rather than chemical UV filters; physical UV filters are less likely to irritate young children's sensitive skin. Teens might want an oil-free sunscreen for the face to help avoid exacerbations of acne due to thicker, oily preparations. Adults can safely use sunscreen marketed for children.

BOX 4-05 Recommendations for safe sun exposure for travelers

- Avoid direct sun exposure between 10 a.m. and 4 p.m. when ultraviolet (UV) rays are strongest.
- When going outside, opt for shady areas, such as the full shade provided by natural or man-made fixed objects. Trees provide varying degrees of sun protection depending on the density of the foliage.
- Consider using portable shade shelters (e.g., awnings, canopies, umbrellas and parasols, beach tents, similar shade structures). Look for items made with fabrics having a UV protection factor (UPF) >30.
- Wear lightweight long-sleeved garments made of fabric with a UPF >30.
- Wear a hat with circumferential brim ⩾3 inches wide that shades the face, neck, and ears. Do not rely on standard baseball caps; opt for sun-specific caps that include ear and neck flaps, many of which are made of UPF fabrics.
- Wear sunglasses to protect eyes from UV radiation.
- Remember that UV light reflected off water, snow, or sand can amplify UV radiation received.
- Apply a broad-spectrum sunscreen daily, ⩾15 minutes before going outside to allow absorption in the skin's outermost layer.
- Choose a sunscreen that protects against UVA and UVB rays. Use products with a sun protection factor (SPF) ⩾30; to adequately cover the body, apply ⩾1 fluid ounce (equivalent to 2 tablespoons or a shot glass) of sunscreen.
- Reapply sunscreen every 2–4 hours, more frequently when sweating or after being in water. Be sure to apply sunscreen to commonly missed areas (e.g., ears, tops of the feet).
- Apply a lip balm with SPF ⩾30. Remember that many lip balms are simply petrolatum-based moisturizers for chapped lips; look specifically for products labeled as SPF 30 or more.

Source: Adapted from the American Academy of Dermatology Association's Practice Safe Sun guidelines. Available from www.aad.org/public/everyday-care/sun-protection/shade-clothing-sunscreen/practice-safe-sun.

APPLYING SUNSCREEN

Guidelines for sunscreen use recommend regular application of lotions or cream-based broad-spectrum UVA and UVB blocking (SPF ≥30) products (see Box 4-05). People should reapply sunscreen to all exposed areas every 2–4 hours. The average adult needs 1 fluid ounce (1 shot glass full) for each application. People should gently and evenly spread sunscreen, not rub in, on all exposed skin ≥15 minutes prior to going outside to allow UVR blocking effects to penetrate the outer skin layers. Stick or roll-on sunscreens are easy to apply, but people often apply these unevenly, leading to sunburned areas missed during application. If travelers choose to use these products, they should gently spread the product after application.

SPRAY SUNSCREENS

People often apply spray sunscreens unevenly, especially under breezy conditions. Consumer Reports (July 2020) recommends holding the spray nozzle 1 inch from the skin and spraying until the skin glistens uniformly, then gently spreading the product to evenly coat the skin, even if the product claims to be "no rub." Some environmental health organizations discourage use of spray sunscreens because the contents are as likely to get into the environment as they are to get onto a person's skin.

People should avoid spraying the sunscreen on or near the face, because the particulate components can injure the eyes or damage lung tissue if inhaled. People should spray their palms and then apply the sunscreen to their faces. Similarly, parents or guardians should avoid spray products for small children due to risks for inhalation and getting product in children's eyes; adults should spray product on their own hands and then apply onto the child's skin.

Protective Clothing

Sun-protective garments (e.g., pants, long-sleeved shirts, hats) protect against UVR, but efficacy depends on the fabric. Thicker fabrics with tighter or denser weaves (e.g., denim), offer higher UV Protection Factor (UPF). Like SPF, the UPF of a fabric or material represents the fraction of UVR that penetrates the material. UPF 50, for example, means only 1/50th of the UVR gets through

the fabric; 98% of UVR is blocked. A UPF rating of 15–24 is considered good, 25–39 is very good, and ≥40 is excellent. Many outdoor clothing and active wear manufacturers now use densely woven, lightweight, quick drying, synthetic UPF fabrics to make extremely comfortable shirts, pants, and hats.

Many companies also use UPF fabric to make swim-shirts, also called rash guards. Swim-shirts are available with short or long sleeves or with built-in hoods. Because UPF 50 fabric blocks 98% of UVR, a person does not need to apply sunscreen to surfaces covered by the shirts, and parents might choose these for young children who dislike having sunscreen applied. Surfers, lap swimmers, and open-water swimmers might prefer smaller, tighter sizes for a streamlined (hydrodynamic) feel in the water.

HATS

The ideal hat has a circumferential brim ≥3 inches wide that shades the face, neck, and ears. People should not rely on standard baseball caps for sun protection, because these do not protect the ears or neck. Instead, people should opt for sun-specific caps that include ear and neck flaps, many of which are made of UPF fabrics. These can be quite effective, especially for children.

SUNGLASSES

UVR exposure can have short- and long-term damaging effects on the eyes. UVA can harm central vision by damaging the macula. UVB can damage the anterior eye (cornea and lens); acute exposure can lead to corneal burns, and extended exposure can lead to cataracts. UVR can penetrate clouds and haze, so people should protect their eyes regardless of atmospheric conditions.

Excessive UVB exposure, even over several hours, can cause a corneal sunburn, also called photokeratitis or snow blindness. Photokeratitis causes extremely painful sensitivity to light, often causing a person to keep their eyes closed for several hours or more. Snow blindness can occur when UVR reflected off snow nearly doubles the UV exposure to the eye. Other symptoms include copious tearing (watery eyes), injected sclerae (noninfectious pink eye), or a gritty foreign-body sensation of the eye. These symptoms are usually temporary and rarely cause permanent damage to the eyes.

Long-term UVR exposure can lead to cataract formation, age-related macular degeneration, benign conjunctival growths (called pterygium and pinguecula), and cancers of the eyelids or even the conjunctivae.

Sunglasses provide UV protection for the eyes. Wrap-around sunglasses or those with sun-blocking sidepieces provide the best UV protection. People should choose close-fitting frames that contour to the shape of the face to prevent exposure to direct and reflected UVR from all sides and angles.

People also should choose sunglasses that are rated UV 400; these block nearly 100% of damaging UVR. Lenses should have a uniform tint throughout; although gray tints offer the best color fidelity, tint color (e.g., amber, gray, green) does not affect sun protection efficacy. Polarized or mirrored lenses are not more effective at protecting against UVR. Inexpensive, non-branded sunglasses rated UV 400 are just as effective as expensive, designer-label sunglasses. Parents or guardians should provide appropriate eye protection for children. Some contact lenses offer a modicum of UV protection, but people should also wear sunglasses with contact lenses.

The American Academy of Ophthalmology and the American Optometry Association provide recommendations and information on gradient, transitional, and prescription sunglasses at these websites: Tips for Choosing the Best Sunglasses (www.aao.org/eye-health/glasses-contacts/sunglasses-3); Recommended Types of Sunglasses (www.aao.org/eye-health/glasses-contacts/sunglasses-recommended-types); and Ultraviolet (UV) Protection (www.aoa.org/healthy-eyes/caring-for-your-eyes/uv-protection).

Beach Umbrellas & Sunshade Shelters

Several types of shade shelters are available: umbrellas, canopies, and tents. Many shelters marketed for sunshade combine several features. People should choose a shelter made with a fire-resistant UPF 50 fabric, usually nylon or polyester, and a durable but lightweight frame. Additional features travelers should consider are the size needed to accommodate number of people who will use the shelter at once; the weight and ability to collapse and easily transport the

shelter; water-resistant fabric for rain squalls; open or mesh sides that allow adequate air circulation; ability to securely anchor the shelter to the ground with stakes, fillable sandbags, or a combination; and easy assembly, ideally by 1 person. Standard camping tents generally are unsuitable for sun shelters.

Travelers should select beach umbrellas with ample diameter and directional tilt, so the protective field can be adjusted as the sun rises and crosses the sky. Tall umbrellas with a small surface area lose their protective benefits when the sun is at a low angle. Wind gusts can uproot and launch umbrellas, posing a safety hazard. Therefore, people should select an umbrella with parts that can be attached securely to each other and placed firmly in the ground. Screw-type bases can anchor an umbrella in the sand, but usually are sold separately. Travelers should be aware that some public beaches limit the size of shade shelters that can be used.

SUNLESS TANNING

Topical sunless tanning products are a safer way people can gain a tanned look. Although these products make the skin appear darker, they do not provide photoprotection, and travelers should still use sunscreen when exposed to UVR. Sunless tanning products can produce streaking when people sweat or go swimming and can generate an unnatural orange hue on areas of the skin where applied.

Many people believe that getting a pre-vacation tan by using tanning beds will help protect them from vacation sunburns. However, tanning bed lights rely on UVA, which is associated with premature aging. Tanning by this method is roughly equivalent to using an SPF 4 sunscreen, which will not prevent sunburns or other forms of solar damage.

ADDITIONAL SOURCES OF INFORMATION

Consumer Reports (CR) and the Environmental Working Group (EWG) review and rate sunscreen products and their components annually. In general, CR ratings (www.consumerreports.org/products/sunscreens-34523/sunscreen-33614/view2) emphasize human safety, ease of use, truth in advertising, cost, and performance, while the EWG (www.ewg.org/sunscreen) emphasizes environmental safety. Both identify sunscreens by brand name.

BIBLIOGRAPHY

American Cancer Society. Skin cancer. Available from: www.cancer.org/cancer/skin-cancer.html.

Diaz JH, Nesbitt Jr. T. Sun exposure behavior and protection: recommendations for travelers. J Travel Med. 2013;20(2):108–18.

Fivenson D, Sabzevari N, Qiblawi S, Blitz J, Norton BB, Norton SA. Sunscreens: UV filters to protect us. Part 2: Increasing awareness of UV filters and their potential toxicities to us and our environment. Int J Womens Dermatol. 2020;7(1):45–69.

Mitchelmore CL, Burns EE, Conway A, Heyes A, Davies IA. A critical review of organic ultraviolet filter exposure, hazard, and risk to corals. Environ Toxicol Chem. 2021;40(4):967–88.

Monteiro AF, Rato M, Martins C. Drug-induced photosensitivity: photoallergic and phototoxic reactions. Clin Dermatol. 2016;34:571.

Religi A, Backes C, Moccozet L, Vuilleumier L, Vernez D, Bulliard JL. Body anatomical UV protection predicted by shade structures: a modeling study. Photochem Photobiol. 2018;94(6):1289–96.

Sabzevari N, Qiblawi S, Norton SA, Fivenson D. Sunscreens: UV filters to protect us. Part 1: Changing regulations and choices for optimal sun protection. Int J Womens Dermatol. 2021;7(1):28–44.

Skin Cancer Foundation. Sun protection: your daily sun protection guide. Available from: www.skincancer.org/prevention/sun-protection.

Suh S, Pham C, Smith J, Mesinkovska NA. The banned sunscreen ingredients and their impact on human health: a systematic review. Int J Dermatol. 2020;59(9):1033–42.

US Preventive Services Task Force; Grossman DC, Curry SJ, Owens DK, Barry MJ, Caughey AB, Davidson KW, et al. Behavioral counseling to prevent skin cancer: US Preventive Services Task Force recommendation statement. JAMA. 2018;319(11):1134–42.

Wood C. Sun and skin: is travel health advice needed? Travel Med Infect Dis. 2013;11(6):438–9.

Young AR, Claveau J, Rossi AB. Ultraviolet radiation and the skin: photobiology and sunscreen photoprotection. J Am Acad Dermatol 2017;76:S100.

EXTREMES OF TEMPERATURE

Howard Backer, David Shlim

International travelers encounter extremes of climate to which they might not be accustomed. Exposure to heat and cold can result in serious injury or death. Travelers should investigate the climate extremes they will face during their journey and prepare themselves with knowledge, proper clothing, and equipment to prevent problems. Travelers should also be aware that climate change is expanding the range and severity of exposure to heat across many travel destinations. Regions with wide temperature fluctuation present risk for both heat and cold problems.

HEAT-RELATED ILLNESS

Risk for Travelers

Heat-related illness is most often seen in occupational, military, and competitive sport activities, but also can occur from recreational activities. Many of the most popular travel destinations are hot tropical or arid areas. Travelers who sit on the beach or by the pool and do only short walking tours incur minimal risk for heat-related illness. People participating in more strenuous activities (e.g., hiking or biking) in hot environments are at greater risk, especially those coming from cool or temperate climates who are not in good physical condition and who are unacclimatized to heat.

Physiology

Unlike in the cold, where adaptive behaviors play a more important role in body heat conservation, tolerance to heat depends largely on physiologic factors. Heat regulation depends on a combination of physiological and environmental factors. The major means of heat dissipation are radiation while at rest and evaporation of sweat during exercise, both of which become minimal when air temperatures are above 95°F (35°C) and humidity is high.

Cardiovascular status and conditioning are the major physiologic variables affecting the response to heat stress at all ages. Two major organ systems are most critical in temperature regulation: the cardiovascular system, which must increase blood flow to shunt heat from the core to the surface while meeting the metabolic demands of exercise; and the skin, where sweating and heat exchange take place. Many chronic illnesses limit tolerance to heat and predispose people to heat-related illness, most importantly, cardiovascular disease, diabetes, renal disease, certain medications, and extensive skin disorders or scarring that limit sweating.

Apart from environmental conditions and intensity of exercise, dehydration is the most important predisposing factor in heat-related illness. Dehydration reduces exercise performance, decreases time to exhaustion, and increases internal heat load. Temperature and heart rate increase in direct proportion to the level of dehydration. Sweat is a hypotonic fluid containing sodium and chloride. Sweat rates commonly reach 1 liter per hour or more, resulting in substantial fluid and sodium loss.

Clinical Presentations

MILD

Mild heat-related problems can be treated in the field and usually do not require medical evaluation or evacuation.

Heat cramps are painful muscle contractions that begin ≥1 hours after stopping exercise and most often involve heavily used muscles in the calves, thighs, and abdomen. Rest and passive stretching of the muscle, supplemented by commercial rehydration solutions or water and salt, rapidly relieve symptoms. Drinking water and eating a salty snack also is sufficient. Travelers can make a simple oral salt solution, as described for heat exhaustion.

Heat edema, another mild heat-related illness, occurs more frequently in women than in men. Characterized by mild swelling of the hands and feet during the first few days of heat exposure, this condition typically resolves spontaneously. Travelers should not treat heat edema

with diuretics, which can delay heat acclimatization and cause dehydration.

Prickly heat (miliaria or heat rash) manifests as small, red, raised itchy bumps on the skin and is caused by obstruction of the sweat ducts. Prickly heat resolves spontaneously, aided by relief from heat and avoiding continued sweating. Travelers can best prevent prickly heat by wearing light, loose clothing and avoiding heavy, continuous sweating.

MODERATE

Moderate and severe heat-related illnesses present with collapse (syncope) or inability to continue exertion in heat and are treated similarly with rest, removal from heat or direct sun, and administering fluids and salt.

HEAT SYNCOPE

Heat syncope—sudden fainting caused by vasodilation—occurs in unacclimated people standing in the heat or after 15–20 minutes of exercise. Consciousness rapidly returns when the patient is supine. Rest, relief from heat, and oral rehydration are mainstays of treatment.

HEAT EXHAUSTION

Most people who experience symptoms associated with exercise in the heat or the inability to continue exertion in the heat are suffering from heat exhaustion. The presumed cause of heat exhaustion is loss of fluid and electrolytes, but there are no objective markers to define the syndrome. Transient mental changes (e.g., irritability, confusion, irrational behavior) might be present in heat exhaustion, but major neurologic signs (e.g., seizures, coma) indicate heat stroke or profound hyponatremia. Body temperature could be normal or mildly to moderately elevated. Heat exhaustion also can develop over several days in unacclimatized people and often is misdiagnosed as "summer flu" because of findings of weakness, fatigue, headache, dizziness, anorexia, nausea, vomiting, and diarrhea.

Most cases of heat exhaustion can be treated with supine rest in the shade or other cool place and oral water or fluids containing glucose and salt; subsequently, spontaneous cooling occurs, and patients recover within hours. Travelers can prepare a simple oral salt solution by adding one-fourth to one-half teaspoon (1/4–1/2 tsp) of table salt (or two 1-g salt tablets) to 1 liter (33 oz) of water. To improve taste, add a few teaspoons of sugar or orange or lemon juice to the mixture. Commercial sports-electrolyte drinks also are effective. Plain water plus salty snacks might be more palatable and equally effective. Without cessation of activity and passive or active cooling measures (see below), heat exhaustion can progress to heat stroke.

SEVERE

Severe heat-related illness requires medical evacuation and emergency medical attention.

HEAT STROKE

Heat stroke is a medical emergency requiring aggressive cooling measures and hospitalization for support. Heat stroke is the only form of heat-related illness in which the mechanisms for thermal homeostasis have failed, and the body does not spontaneously restore the temperature to normal. Uncontrolled fever and circulatory collapse cause organ damage to the brain, kidneys, liver, and heart. Damage is related to duration and peak elevation of body temperature.

Onset of heat stroke can be acute or gradual. Acute (also known as exertional) heat stroke is characterized by collapse while exercising in the heat, usually with profuse sweating. It can affect healthy, physically fit people. By contrast, gradual or nonexertional (referred to sometimes as classic or epidemic) heat stroke occurs in chronically ill people experiencing passive exposure to heat over several days. Sufferers of nonexertional heat stroke might not perspire. Victims of both exertional and nonexertional heat stroke demonstrate altered mental status and markedly elevated body temperature.

Early symptoms are similar to those of heat exhaustion, including confusion or change in personality, loss of coordination, dizziness, headache, and nausea, but these progress to more severe symptoms. A presumptive diagnosis of heat stroke is made in the field when people have body temperature ≥104°F (≥41°C) and marked alteration of mental status, including delirium, convulsions, and coma; even without a thermometer, people

BOX 4-06 Heat stroke management

In the field, maintain the airway if victim is unconscious, and immediately institute cooling measures by these methods, if available:

Move the victim to the shade or some cool place out of the sun.

Use evaporative cooling: remove excess clothing to maximize skin exposure, spray tepid water on the skin, and maintain air movement over the body by fanning. Alternatively, place cool or cold wet towels over the body and fan to promote evaporation.

Apply ice or cold packs to the neck, axilla, groin, and as much of the body as possible. Vigorously massage the skin to limit constriction of blood vessels and to prevent shivering, which will increase body temperature.

Immerse the victim in cool or cold water (e.g., a nearby pool, natural body of water, bath). An ice bath cools fastest. Always attend and hold the person while in the water.

Encourage rehydration for those able to take oral fluids.

with heat stroke will feel hot to the touch. If a thermometer is available, a rectal temperature is the safest and most reliable way to check the temperature of someone with suspected heat stroke; an axillary temperature might give a reasonable estimation. See Box 4-06 for additional guidance on managing heat stroke.

Heat stroke is life threatening, and many complications occur in the first 24–48 hours, including liver or kidney damage and abnormal bleeding. Most victims have significant dehydration, and many require hospital intensive care management to replace fluid losses. If evacuation to a hospital is delayed, patients should be monitored closely for several hours for temperature swings.

EXERCISE-ASSOCIATED HYPONATREMIA

Hyponatremia occurs in both endurance athletes and recreational hikers due to physiologic mechanisms that result in failure of the kidneys to correct salt and fluid imbalances properly. Excess fluid retention occurs when antidiuretic hormone (secreted inappropriately) influences the kidneys to both retain water and excrete sodium. Sodium losses through sweat also contribute to hyponatremia.

In the field setting, altered mental status in a patient with normal body temperature and a history of taking in large volumes of water suggests hyponatremia. Excessive water ingestion is also a major contributor to exercise-associated hyponatremia; the recommendation to force fluid intake during prolonged exercise and the attitude that "you can't drink too much" is outdated and dangerous. Prevention includes drinking only enough to relieve thirst. During prolonged exercise (>12 hours) or heat exposure, people should take supplemental sodium. Most sports-electrolyte drinks do not contain sufficient sodium to prevent hyponatremia; on the other hand, salt tablets often cause nausea and vomiting. For recreational athletes, food is the most efficient vehicle for salt replacement. Snacks should include not just sweets, but salty foods (e.g., trail mix, crackers, pretzels).

Symptoms of heat exhaustion and early exercise-associated hyponatremia are similar, including anorexia, nausea, emesis, headache, muscle weakness, and lethargy; hyponatremia symptoms can, however, progress to confusion and seizures, and coma. Severe hyponatremia can be distinguished from other heat-related illnesses by persistent alteration of mental status without elevated body temperature, delayed onset of major neurologic symptoms, or deterioration hours after cessation of exercise and removal from heat. Where medical care and clinical laboratory resources are available, clinicians can measure the patient's serum sodium to diagnose hyponatremia and guide treatment.

Treating clinicians should restrict fluid if hyponatremia is suspected (neurologic symptoms in the absence of hyperthermia or other diagnoses). If the patient is conscious and can tolerate oral intake, clinicians should give salty snacks with sips of water or a solution of concentrated broth (2–4 bouillon cubes in 1/2 cup of water). Obtunded hyponatremic patients require hypertonic saline.

Prevention

CLOTHING

Travelers should wear lightweight, loose, light-colored clothing that allows maximum air circulation for evaporation but also gives protection from the sun (see Sec. 4, Ch. 1, Sun Exposure). In addition, travelers can wear a wide-brimmed hat, which can markedly reduce radiant heat exposure.

FLUID & ELECTROLYTE REPLACEMENT

During exertion, fluid intake improves performance and decreases the likelihood of illness. Reliance on thirst alone is not sufficient to prevent mild dehydration, and forcing a person who is not thirsty to drink water increases the risk of hyponatremia. During mild to moderate exertion, electrolyte replacement offers no advantage over plain water. A person exercising for many hours in the heat should replace salt by eating salty snacks or by lightly salting mealtime food or fluids. Salt tablets swallowed whole can cause gastrointestinal irritation and vomiting; tolerability can be improved by dissolving tablets in 1 L of water. Using urine volume and color to monitor fluid needs is most accurate in the morning.

HEAT ACCLIMATIZATION

Heat acclimatization is a process of physiologic adaptation that occurs in residents of and visitors to hot environments. Increased sweating that contains less salt, and decreased energy expenditure with lower rise in body temperature for a given workload, is the result. Only partial adaptation occurs from passive exposure to heat. Full acclimatization, especially cardiovascular, requires 1–2 hours of exercise in the heat each day. With a suitable amount of daily exercise, most acclimatization changes occur within 10 days. Decay of acclimatization occurs within days to weeks if there is no heat exposure.

PHYSICAL CONDITIONING

If possible, all travelers should acclimatize before departing for hot climates by exercising ≥1 hour daily in the heat. Physically fit travelers have improved exercise tolerance and capacity but still benefit from acclimatization. If this is not possible, clinicians should advise travelers to limit exercise intensity and duration during their first week of travel. Travelers also should try to conform to the local practice in most hot regions and avoid strenuous activity during the hottest part of the day.

COLD-RELATED ILLNESS & INJURY

Risk for Travelers

Travelers do not have to be in an arctic or high-elevation environment to encounter problems with cold. Humidity, rain, and wind can produce hypothermia with temperatures around 50°F (10°C). Even in temperate climates, people can rapidly become hypothermic in water. Although reports of severe hypothermia in international travelers are rare, people planning trips to wilderness areas should be familiar with the major mechanisms of heat loss (convection, conduction, and radiation) and how to mitigate them by taking shelter from the wind, getting and staying dry, and keeping warm by building a fire.

Being caught without shelter in a wilderness environment represents a significant risk for accidental hypothermia. Many high-elevation travel destinations, however, are not wilderness areas. Local inhabitants and villages offer shelter and protection from extreme cold weather. In Nepal, for example, trekkers almost never experience hypothermia except in rare instances in which they get lost in a storm.

Clinical Presentations

HYPOTHERMIA

Hypothermia is defined as a core body temperature <95°F (<35°C). When people are faced with an environment in which they cannot keep warm, they first feel chilled, then they shiver, and eventually they stop shivering because their metabolic reserves are exhausted. Body temperature continues to decrease, depending on ambient temperatures. As core body temperature falls, neurologic function decreases; almost all hypothermic people with a core temperature of ≤86°F (≤30°C) are comatose. The record low core body temperature in an adult who survived is 56°F (13°C).

Travelers heading to cold climates should ask questions and research clothing and equipment. Modern clothing, gloves, and particularly footwear

have greatly decreased the chances of suffering cold injury in extreme climates. Cold-related illness and injury occurs more often after accidents (e.g., avalanches, unexpected nights outside) than during normal recreational activities.

People engaging in recreational activities or working around cold water face a different sort of risk. Within 15 minutes, immersion hypothermia can render a person unable to swim or float. In these cases, a personal flotation device is critical, as is knowledge about self-rescue and righting a capsized boat.

Other medical conditions associated with cold affect mainly the skin and the extremities. These can be divided into nonfreezing cold injuries and freezing injuries (frostbite).

NONFREEZING COLD INJURY

Nonfreezing cold-related injuries include trench foot (immersion foot), pernio (chilblains), and cold urticaria. Trench foot is caused by prolonged immersion of the feet in cold water (32°F–59°F; 0°C–15°C). The damage is mainly to nerves and blood vessels, and the result is pain aggravated by heat and a dependent position of the limb. Severe cases can take months to resolve. Unlike frostbite, avoid rapid rewarming of trench foot, which can make the damage much worse.

Pernio are localized, inflammatory lesions occurring mainly on the hands after exposure to only moderately cold weather. The bluish-red lesions are thought to be caused by prolonged, cold-induced vasoconstriction. Rapid rewarming makes the pain worse; slow rewarming is preferred. Nifedipine can be an effective treatment.

Cold urticaria are localized or general wheals with itching. The rate of change of temperature, not the absolute temperature, induces this form of skin lesion. If cold urticaria occur regularly in a traveler, they can be prevented or ameliorated by prior treatment with antihistamines.

FREEZING COLD INJURY

Frostbite describes tissue damage caused by direct freezing of the skin. Once severe tissue damage occurs, little can be done. Fortunately, modern equipment and clothing are available to protect adventure tourists from frostbite. The condition now occurs mainly as the result of accidents, severe unexpected weather, or failure to plan appropriately.

Frostbite is usually graded like burns. First-degree frostbite involves reddening of the skin without deeper damage. The prognosis for complete healing is virtually 100%. Second-degree frostbite involves blister formation. Blisters filled with clear fluid have a better prognosis than blood-tinged blisters. Third-degree frostbite represents full-thickness injury to the skin and possibly the underlying tissues. No blisters form, the skin darkens over time and might turn black. If the tissue is completely devascularized, amputation will be necessary.

Severely frostbitten skin is numb and appears whitish or waxy. The generally accepted method for treating a frozen digit or limb is rapid rewarming in water heated to 104°F–108°F (40°C–42°C). Immerse the frozen area completely in the heated water. Use a thermometer to ensure the water is kept at the correct temperature. Rewarming can be associated with severe pain, so analgesics should be given if needed. Once rewarmed, protect frostbitten skin against freezing again. It is better to keep digits frozen a little longer and rapidly rewarm them than to allow them to thaw out slowly or to thaw and refreeze. A cycle of freeze-thaw-refreeze is devastating to tissue, often resulting in amputation.

Once the area has rewarmed, examine for blisters, and note whether the blisters extend to the end of the digit. Proximal blisters usually mean that the tissue distal to the blister has suffered full-thickness damage. For treatment, avoid further mechanical trauma to the area and prevent infection. In the field, wash the area thoroughly with a disinfectant (e.g., povidone iodine), put dressings between the toes or fingers to prevent maceration, use fluffs (expanded gauze sponges) for padding, and cover with a roller gauze bandage. These dressings can be left on safely for up to 3 days at a time. Prophylactic antibiotics are not needed in most situations.

In the rare situation in which a foreign traveler suffers frostbite and can be evacuated to an advanced medical setting within 24–72 hours, there may be a role for thrombolytic agents (e.g., prostacyclin, recombinant tissue plasminogen activator). Clinicians managing a case of frostbite

within the first 72 hours should carefully consider the risks and benefits of using these drugs; consultation with an expert is strongly recommended. Beyond 72 hours after thawing, these interventions probably are not beneficial.

Once a patient with frostbite has reached a definitive medical setting, clinicians should not rush to do surgery. The usual time from injury to surgery is 4–5 weeks. Clinicians can use technetium-99m (Tc-99m) scintigraphy and magnetic resonance imaging to define the extent of the damage. Once the delineation between dead and viable tissue becomes clear, clinicians can plan surgery that preserves the remaining digits.

BIBLIOGRAPHY

Aleeban M, Mackey TK. Global health and visa policy reform to address dangers of Hajj during summer seasons. Front Public Health. 2016;4:280.

Armstrong LE, Casa DJ, Millard-Stafford M, Moran DS, Pyne SW, Roberts WO. American College of Sports Medicine position stand. Exertional heat illness during training and competition. Med Sci Sports Exerc. 2007;39(3):556–72.

Asplund CA, O'Connor FG, Noakes TD. Exercise-associated collapse: an evidence-based review and primer for clinicians. Br J Sports Med. 2011;45(14):1157e62.

Bennett BL, Hew-Butler T, Rosner MH, Myers T, Lipman GS. Wilderness Medical Society clinical practice guidelines for the management of exercise-associated hyponatremia: 2019 update. Wilderness Environ Med. 2020;31(1)50–62.

Cauchy E, Cheguillaume B, Chetaille E. A controlled trial of a prostacyclin and rt-PA in the treatment of severe frostbite. N Engl J Med. 2011;364(2):189–90.

Epstein Y, Moran DS. Extremes of temperature and hydration. In: Keystone JS, Kozarsky PE, Connor BA, Nothdurft HD, Mendelson M, Leder K, editors. Travel medicine 4th edition. Philadelphia: Elsevier; 2019. pp. 407–16.

Freer L, Handford C, Imray CHE. Frostbite. In: Auerbach PS, editor. Wilderness medicine, 7th edition. Philadelphia: Elsevier; 2017. pp. 197–221.

Hadad E, Rav-Acha M, Heled Y, Epstein Y, Moran DS. Heat stroke: a review of cooling methods. Sports Med. 2004;34(8):501–11.

Lipman GS, Gaudio FG, Eifling KP, Ellis MA, Otten EM, Grissom CK. Wilderness Medical Society clinical practice guidelines for the prevention and treatment of heat illness: 2019 update. Wilderness Environ Med. 2019;30(4S):S33–46.

McDermott BP, Anderson SA, Armstrong LE, Casa DJ, Cheuvront SN, Cooper L, et al. National Athletic Trainers' Association position statement: fluid replacement for the physically active. J Athl Train. 2017;52(9):877–895.

O'Brien KK, Leon LR, Kenefick RW, O'Connor FG. Clinical management of heat-related illnesses. In: Auerbach PS, editor. Wilderness medicine, 7th edition. Philadelphia: Elsevier; 2019. pp. 267–75.

AIR QUALITY & IONIZING RADIATION

Audrey Pennington, Armin Ansari

Although air pollution has decreased in many parts of the world, it represents a major and growing health problem for the residents of some cities in certain industrializing countries. Polluted air can be difficult or impossible for travelers to avoid; the risk is generally low, however, for otherwise healthy people who have only limited exposure. Conversely, those with preexisting heart and lung disease, children, and older adults have an increased risk for adverse health effects from even short-term exposure to air pollution.

AIR QUALITY

Travelers, particularly people with underlying cardiorespiratory disease, should investigate the air quality at their destination. The AirNow website (http://airnow.gov) provides basic information about local air quality by using the Air Quality

Table 4-01 Air quality index levels

AIR QUALITY INDEX LEVELS	AIR QUALITY INDEX VALUES	DESCRIPTION
Good	0–50	Satisfactory air quality Air pollution poses little or no risk
Moderate	51–100	Acceptable air quality Some pollutants could represent a moderate health concern for members of sensitive groups
Unhealthy for sensitive groups	101–150	Members of sensitive groups might experience health effects General public not likely to be affected
Unhealthy	151–200	Everyone could begin to experience health effects Sensitive groups might experience more serious health effects
Very unhealthy	201–300	Health alert: everyone might experience more serious health effects
Hazardous	301–500	Health warnings of emergency conditions Entire population is more likely to be affected

Source: Air Quality Index Basics. Available from: www.airnow.gov/aqi/aqi-basics.

Index (AQI) (Table 4-01). The World Air Quality Index (https://waqi.info) project shows real-time air quality and air pollution data for >10,000 air stations in >80 countries around the world, and the World Health Organization posts historical data on outdoor air pollution in urban areas (http://gamapserver.who.int/gho/interactive_charts/phe/oap_exposure/atlas.html).

Dust masks, surgical masks, and bandanas offer limited protection against severely polluted air. When air is severely polluted (e.g., during wildland fires), the best protection strategies are to avoid prolonged time spent outdoors and to be aware of guidance or directives from local health or emergency management officials (see Wildfire Smoke Factsheet: Protect Your Lungs from Wildfire Smoke or Ash, www.epa.gov/sites/default/files/2018-11/documents/respiratory_protection-no-niosh-5081.pdf). Respirators are specifically designed to remove contaminants from the air or to provide clean respirable air from another source. The National Institute for Occupational Safety and Health (NIOSH) provides a testing, approval, and certification program for respirators (www.cdc.gov/niosh/npptl/topics/respirators/cel/default.html). Parents should be aware that NIOSH does not currently certify respirators for children.

Travelers should be mindful of, and limit exposures to, outdoor and indoor air pollution and carbon monoxide (Table 4-02). Secondhand smoke from smoking tobacco is a primary contributor to indoor air pollution. Other potential sources of indoor air pollutants include cooking or combustion sources (e.g., kerosene, coal, wood, animal dung). Major sources of indoor carbon monoxide include methane gas ranges and ovens, unvented gas or kerosene space heaters, and coal- or wood-burning stoves. Ceremonial incense and candles are asthma triggers that often are not recognized.

Mold

Travelers might visit flooded areas as part of emergency, medical, or humanitarian relief missions. Water damage to buildings can lead to mold contamination. Mold is a more serious health hazard for immunocompromised people and for those who have respiratory problems (e.g., asthma). To prevent exposures that could result in adverse health effects, travelers should avoid areas where mold contamination is obvious, and use personal protective equipment (PPE) such as gloves,

Table 4-02 Strategies to mitigate adverse health effects of air pollution

ENVIRONMENTAL SOURCE	POLLUTANTS	TRAVELER CATEGORY	MITIGATION STRATEGIES
Indoor air	High levels of smoke (e.g., from cooking and combustion sources, tobacco, incense, and candles)	Long-term travelers and expatriates	Consider purchasing indoor air filtration system
		All travelers	Avoidance
Outdoor air	Poor air quality (high levels of air pollution) or areas potentially affected by wildland fires	Travelers with preexisting asthma, chronic obstructive pulmonary disease, heart disease	Limit strenuous or prolonged outdoor activity
		All travelers	Facemasks (offer limited protection)

goggles, waterproof boots, and NIOSH-approved N95 or higher respirators when working in moldy environments. To learn more about mold and respirators, see the Centers for Disease Control and Prevention (CDC) website, Respiratory Protection for Residents Reentering and/or Cleaning Homes that Were Flooded (www.cdc.gov/disasters/disease/respiratory.html). Travelers should anticipate the environment to which they are traveling and bring enough PPE, because supplies might be scarce or unavailable in the countries visited. Travelers should keep hands, skin, and eyes clean and free from mold-contaminated dust. For additional information, review CDC recommendations, Mold Cleanup and Remediation, at www.cdc.gov/mold/cleanup.htm.

RADIATION

Background radiation levels can vary substantially from region to region, but these variations are natural and do not represent a health concern. Several regions in the world have high natural background radiation, including Guarapari (Brazil), Kerala (India), Ramsar (Iran), and Yangjiang (China), but traveling to these areas does not pose a threat to health. By contrast, travelers should be aware of and avoid regions known to be contaminated with radioactive materials (e.g., areas surrounding the Chernobyl nuclear power plant in Ukraine and the Fukushima Daiichi nuclear power plant in Japan). These areas have radiation levels that greatly exceed background levels and represent a substantial health and safety risk.

The Chernobyl nuclear power plant is located 100 km (62 miles) northwest of Kyiv. The 1986 incident that occurred at that facility contaminated regions in 3 republics—Ukraine, Belarus, and Russia—but the highest radioactive ground contamination is ≤30 km (19 miles) of Chernobyl.

The Fukushima Daiichi plant is located 240 km (150 miles) north of Tokyo. After the accident in 2011, the area within a 20-km (12-mile) radius of the plant was evacuated. Japanese authorities also advised evacuation from locations farther away to the northwest of the plant. Because Japanese authorities continue to clean the affected areas and monitor the situation, access requirements and travel advisories change. The US Department of State recommends against all unnecessary travel to areas designated by the Japanese government to be restricted because of radioactive contamination. For up-to-date safety information or current travel advisories for any country, see the US Department of State's website (https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories.html) or check with the US embassy or consulate in that country.

In most countries, areas of known radioactive contamination are fenced or marked with signs. Any traveler seeking long-term (more than a few

months) residence near a known or suspected contaminated area should consult with staff of the nearest US embassy, and inquire about any advisories regarding drinking water quality or purchase of meat, fruit, and vegetables from local farmers.

Radiation emergencies are rare. In case of such an emergency, travelers should follow instructions provided by local authorities. If such information is not forthcoming, US travelers should seek advice from the nearest US embassy or consulate.

Natural disasters (e.g., floods) might displace industrial or clinical radioactive sources. In all circumstances, travelers should exercise caution when they encounter unknown objects or equipment, especially if the objects have the basic radiation trefoil symbol or other radiation signs (for examples, see https://remm.hhs.gov/radsign.htm). Travelers who encounter a questionable object should avoid touching or moving it, and notify local authorities as quickly as possible.

BIBLIOGRAPHY

Ansari A. Radiation threats and your safety: a guide to preparation and response for professionals and community. Boca Raton, FL: Chapman & Hall/CRC; 2009.

Brandt M, Brown C, Burkhart J, Burton N, Cox-Ganser J, Damon S, et al. Mold prevention strategies and possible health effects in the aftermath of hurricanes and major floods. MMWR Recomm Rep. 2006;55(RR-8):1–27.

Brook RD, Rajagopalan S, Pope CA 3rd, Brook JR, Bhatnagar A, Diez-Roux AV, et al. Particulate matter air pollution and cardiovascular disease: an update to the scientific statement from the American Heart Association. Circulation. 2010;121(21):2331–78.

Cohen AJ, Brauer M, Burnett R, Anderson HR, Frostad J, Estep K, et al. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the global burden of diseases study 2015. Lancet. 2017;389(10082):1907–18.

Eisenbud M, Gesell TF. Environmental radioactivity: from natural, industrial, and military sources, 4th edition. San Diego: Academic Press; 1997.

Guarnieri M, Balmes JR. Outdoor air pollution and asthma. Lancet. 2014;383(9928):1581–92.

Shaffer R, Cichowicz J, Chew G, Hsu J. Non-occupational uses of respiratory protection—what public health organizations and users need to know. NIOSH Science blogs. January 4, 2018. Available from: https://blogs.cdc.gov/niosh-science-blog/2018/01/04/respirators-public-use.

US Environmental Protection Agency. Wildfire smoke: a guide for public health officials. Research Triangle Park, NC: EPA-452/R-19-901; 2019.

SCUBA DIVING: DECOMPRESSION ILLNESS & OTHER DIVE-RELATED INJURIES

Daniel Nord, Gregory Raczniak, James Chimiak

Published estimates report anywhere from 0.5 million to 4 million people in the United States participate in recreational diving; many travel to tropical areas of the world to dive. Divers face a variety of medical challenges, but because dive injuries generally are rare, few clinicians are trained to prevent, diagnose, or treat them. Recreational divers should assess potential risks before diving, be prepared to recognize signs of injury, and seek qualified dive medicine help promptly when needed.

PREPARING FOR DIVE TRAVEL

When assisting patients who are planning dive-related travel, take into consideration chronic health conditions, any recent changes in health (e.g., injuries, pregnancy, surgeries), and medication use. Underlying respiratory conditions (e.g.,

asthma, chronic obstructive pulmonary disease, infections, history of spontaneous pneumothorax) can challenge the breathing capacity required of divers. Mental health disorders (e.g., anxiety, claustrophobia, substance abuse) and disorders affecting central nervous system higher function and consciousness (e.g., seizures) raise special concerns about diving fitness. While it is important to review patient medications for their compatibility with diving, usually the primary concern is the underlying condition for which the patient takes medication.

People with known risk factors for coronary artery disease, including but not limited to diabetes, elevated blood pressure, family history, an abnormal lipid profile, and smoking history, who wish to either begin a dive program or continue diving, should undergo a physical examination to assess their cardiovascular fitness. This examination might include an electrocardiogram, exercise treadmill test, or echocardiogram. Diving is a potentially strenuous activity that can put substantial demands on the cardiovascular system. Serious injury and death are associated with poor physical conditioning; regular aerobic exercise should already be part of a diver's routine before arriving for their dive physical and subsequent diving.

During the travel medicine examination, remind divers (and would-be divers) of actions they can take in advance to reduce or eliminate risks. Identifying and assessing potential hazards (e.g., environment, water and weather conditions, planned depth and bottom time) can help divers make decisions about acceptable risk. Preparing for a safe dive also includes having an up-to-date emergency action plan, on-hand first aid supplies (with ample oxygen), and reliable communication devices. Using correct and well-maintained protective equipment, diving with supervision, and ensuring that medical care is available in the event of an emergency are other controls divers can implement. A diver should never feel compelled to make a dive, especially if feeling unwell.

Of special note, many dive operators routinely screen clients by requiring a medical statement signed by the diver's physician with approval to dive. Divers should communicate with their dive operator ahead of travel to acquire the necessary form to share with their personal physician. By being prepared with properly signed documentation upon arrival at their dive destination, the traveling diver can forestall denial of dive privileges.

DIVING DISORDERS

Barotrauma

Barotrauma is an injury to soft tissues resulting from a pressure differential between an airspace in the body and the ambient pressure. The resultant expansion or contraction of that space can cause injury.

EAR & SINUS

The most common injury in divers is ear barotrauma (Box 4-07). On descent, failure to equalize pressure changes within the middle ear space creates a pressure gradient across the eardrum. As the middle ear tissues swell with edema—a consequence of the increased pressure—the pressure difference across the eardrum pushes it into the middle ear space, causing it to bleed and possibly rupture.

Forceful equalization under these conditions can increase the pressure differential between the inner ear and the middle ear, resulting in round window rupture with perilymph leakage and inner ear damage. To avoid these pathologic processes, divers must learn proper equalization techniques. Health care providers can coach this effort by

BOX 4-07 Symptoms of ear barotrauma

- Decreased hearing
- Pain
- Sensation of fullness
- Sensation of "water in the ear" (serous fluid/blood accumulation in the middle ear)
- Tinnitus (ringing in the ears)
- Vertigo (dizziness or sensation of spinning)

observing movement of the tympanic membrane using simple otoscopy.

Paranasal sinuses, because of their relatively narrow connecting passageways, are especially susceptible to barotrauma, generally on descent. With small changes in pressure (depth), symptoms are usually mild and subacute but can be exacerbated by continued diving. Larger pressure changes can be more injurious, especially with forceful attempts at equilibration (e.g., the Valsalva maneuver). Additional risk factors for ear and sinus barotrauma include:

- Use of solid earplugs.
- Medication (e.g., overuse or prolonged use of decongestants leading to rebound congestion).
- Ear or sinus surgery.
- Nasal deformity or polyps.
- Chronic nasal and sinus disease that interferes with equilibration during the large barometric pressure changes encountered while diving.

Divers who suspect they have ear or sinus barotrauma should discontinue diving and seek medical attention.

PULMONARY

Scuba divers reduce the risk for lung overpressure problems by breathing normally and ascending slowly when breathing compressed gas. Overexpansion of the lungs can result if a scuba diver ascends toward the surface without exhaling, which can happen, for example, when a novice diver panics and kicks back toward the surface. During ascent, compressed gas trapped in the lung increases in volume until the expansion exceeds the elastic limit of lung tissue, causing damage and allowing gas bubbles to escape into 3 possible locations: the pleural space, mediastinum, or pulmonary vasculature. Gas entering the pleural space can cause lung collapse or pneumothorax. Gas entering the mediastinum (the space around the heart, trachea, and esophagus) causes mediastinal emphysema and frequently tracks under the skin (subcutaneous emphysema) or into the tissue around the larynx, sometimes precipitating a change in voice characteristics. Gas rupturing the alveolar walls can enter the pulmonary capillaries and pass via the pulmonary veins to the left side of the heart, resulting in arterial gas embolism (AGE).

Mediastinal or subcutaneous emphysema might resolve spontaneously, but pneumothorax generally requires specific treatment to remove the air and reinflate the lung. AGE is a medical emergency, requiring urgent intervention with hyperbaric oxygen therapy (recompression treatment).

Lung overinflation injuries from scuba diving can range from mild to dramatic and life threatening. Although pulmonary barotrauma is uncommon in divers, prompt medical evaluation is necessary, and clinicians must rule out this condition in patients presenting with post-dive respiratory or neurologic symptoms.

Decompression Illness

Decompression illness (DCI) describes bubble-related dysbaric injuries, including AGE and decompression sickness (DCS). Because scientists consider these 2 conditions to result from separate causes, they are described here separately. From a clinical and practical standpoint, however, distinguishing between them in the field might be impossible and unnecessary, because the initial treatment is the same for both (Table 4-03). DCI can occur even in divers who have carefully followed the standard decompression tables and the principles of safe diving. Serious permanent injury or death can result from AGE or DCS.

ARTERIAL GAS EMBOLISM

Gas entering the arterial blood through ruptured pulmonary vessels can distribute bubbles into the body tissues, including the heart and brain, where they can disrupt circulation or damage vessel walls. The clinical presentation of arterial gas embolism (AGE) ranges from minimal neurologic findings to dramatic symptoms requiring urgent and aggressive treatment.

In general, suspect AGE in any scuba diver who surfaces unconscious or loses consciousness within 10 minutes after surfacing. Initiate basic life support, including administration of the

Table 4-03 Decompression illness syndromes: clinical findings

ARTERIAL GAS EMBOLISM	DECOMPRESSION SICKNESS
Ataxia Blurred vision Chest pain or bloody sputum Loss of consciousness Convulsions Dizziness Muscular weakness Numbness or paresthesia Paralysis Personality change, difficulty thinking, or confusion	Loss of bowel or bladder function Collapse or unconsciousness Coughing spasms or shortness of breath Dizziness Unusual fatigue Itching Joint aches or pain Mottling or marbling of skin Numbness or tingling Paralysis Personality changes Staggering, loss of coordination, or tremors Weakness

highest fraction of oxygen. Because relapses can and do occur, divers suffering AGE should be rapidly evacuated to a hyperbaric oxygen treatment facility even if they appear to have recovered fully.

DECOMPRESSION SICKNESS ("THE BENDS")

Breathing air under pressure causes excess inert gas (usually nitrogen) to dissolve in and saturate body tissues. The amount of gas dissolved is proportional to, and increases with, the total depth and time a diver is below the surface. As the diver ascends, the excess dissolved gas must be cleared through respiration. Depending on the amount of gas dissolved and the rate of ascent, some gas can supersaturate tissues, where it separates from solution to form bubbles, interfering with blood flow and tissue oxygenation.

Other Conditions Related to Diving

DROWNING

Any incapacitation while underwater can result in drowning (see Sec. 4, Ch. 12, Injury & Trauma).

HAZARDOUS MARINE LIFE

Oceans and waterways are filled with marine animals, most of which are generally harmless unless threatened. Most injuries among divers are the result of chance encounters or defensive maneuvers of marine life. Wounds from marine life have many common characteristics, including bacterial contamination, foreign bodies, bleeding, and occasionally venom. See Sec. 4, Ch. 7, Zoonotic Exposures: Bites, Stings, Scratches & Other Hazards, for prevention and injury management recommendations.

IMMERSION (INDUCED) PULMONARY EDEMA

The normal hemodynamic effects of water immersion account for a shift of fluid from peripheral to central circulation that can result in higher pressures within the pulmonary capillary bed, forcing excess fluid into the lungs. Cold water can cause peripheral vasoconstriction and augment this central fluid shift. Symptoms and signs of immersion (induced) pulmonary edema (IPE) generally begin on descent or at depth and include chest pain, dyspnea, wheezing, and productive cough with frothy, sometimes pink-tinged sputum. Although not entirely well understood, age, overhydration, overexertion, negative inspiratory pressure, and left ventricular hypertrophy are believed to increase IPE risk in otherwise healthy divers. Anyone experiencing acute pulmonary edema while diving requires a work-up to rule out myocardial ischemia, evaluation of left ventricular function, hypertrophy, and valvular integrity.

NITROGEN NARCOSIS

At increasing depths, generally >100 ft (≈30 m), the partial pressure of nitrogen within the breathing

gas increases, causing narcosis in all recreational divers. Nitrogen narcosis can be life threatening when it impairs a diver's ability to make appropriate and proper decisions while under water. This narcosis quickly clears on ascent and is not seen on the surface after a dive, which helps differentiate this condition from AGE.

OXYGEN TOXICITY

At increasing partial pressures of oxygen, levels in the blood become high enough to cause seizures. This condition is not seen when diving on compressed air within recreational depth limits.

DIVING & AIR TRAVEL

Flying after Diving

The risk of developing decompression sickness increases when divers go to increased altitude too soon after a dive. Commercial aircraft cabins are generally pressurized to the equivalent of 6,000–8,000 ft (≈1,830–2,440 m) above sea level. Instruct asymptomatic divers to wait before flying at an altitude or cabin pressure >2,000 ft (610 m) for

- ≥12 hours after surfacing from a single no-decompression dive;
- ≥18 hours after multiple dives or multiple days of diving; or
- 24–48 hours after a dive that required decompression stops.

These recommended preflight surface intervals reduce, but do not eliminate, risk for DCS. Longer surface intervals further reduce this risk.

Diving after Flying

There are no guidelines for diving after flying. Divers should wait a sufficient period to acclimate mentally and physically to their new location to focus solely on the dive.

PREVENTING DIVING DISORDERS

Recreational divers should dive conservatively and well within the no-decompression limits of their dive tables or computers. When multiple dives are planned, strict guidelines, known as surface intervals, are prescribed to allow adequate time for dissolved inert gas to drop to acceptable levels before the next dive. Tables derived from man-tested algorithms have traditionally been used by divers to manually calculate dive times and surface intervals. Dive computers possess the reliability and computing power to use the same algorithms and compute individual guidance based on real-time depth and time inputs. Dive computers have largely replaced the use of tables for the manual process of dive planning.

Risk factors for DCI are primarily dive depth, dive time, and rates of ascent. Additional factors, such as altitude exposure soon after a dive, difficult diving conditions (e.g., colder water, currents, decreased visibility, wave action), dives to depths >60 ft (18 m), multiple consecutive days of diving or repetitive dives, overhead situations (e.g., diving in underwater caves or wrecks), strenuous exercise, and certain physiologic variables (e.g., dehydration), also increase risk. Caution divers to stay well hydrated and rested and dive within the limits of their training. Diving is a skill that requires training and certification and should be done with a well-trained, attentive companion (dive buddy).

TREATMENT OF DIVING DISORDERS

Definitive treatment of DCI begins with early recognition of symptoms, followed by recompression with hyperbaric oxygen. Be suspicious of any unusual symptoms occurring soon after a dive, especially neurological symptoms, and evaluate these properly. Provide a high concentration (100%) of supplemental oxygen; surface-level oxygen given for first aid might relieve the signs and symptoms of DCI and should be administered as soon as possible.

Because of either incidental causes, immersion, or DCI itself, which can cause capillary leakage, divers often are dehydrated. In most cases, treatment includes administering isotonic glucose-free intravenous fluids. Oral rehydration fluids also can be helpful, provided they can be administered safely (i.e., if the diver is conscious and can maintain their airway).

The definitive treatment of DCI is recompression and oxygen administration in a hyperbaric chamber. Stable or remitting symptoms of mild DCI (e.g., constitutional symptoms, some cutaneous sensory changes, limb pain, or rash) in divers

reporting from remote locations without a hyperbaric facility might not require recompression. Medical management decisions made with the assistance of a qualified dive medicine physician also should account for the prevailing circumstances, logistics and hazards of evacuation, and the implications of failing to recompress. Serial neurologic exams are essential to the decision-making process.

Divers Alert Network (DAN) maintains 24-hour emergency consultation and evacuation assistance at +1-919-684-9111 (collect calls accepted). DAN can help with the medical management of injured divers by deciding if recompression is needed, providing the location of the closest recompression facility, and arranging patient transport. Divers and health care providers also can contact DAN for routine, nonemergency consultation by telephone at 919-684-2948, extension 6222, or by accessing the DAN website (https://dan.org/).

Travelers who plan to scuba dive might want to ascertain whether recompression facilities are available at their destination before embarking on their trip.

BIBLIOGRAPHY

Brubakk AO, Neuman TS, Bennett PB, Elliott DH. Bennett and Elliott's physiology and medicine of diving, 5th edition. London: Saunders; 2003.

Chapter 6: Pulmonary and Venous Disorders. In: J. Chimiak, editor. The heart & diving. Durham (NC): Divers Alert Network. Available from: https://dan.org/wp-content/uploads/2020/07/the-heart-and-diving-dan-dive-medical-reference.pdf.

Dear G, Pollock NW. DAN America dive and travel medical guide, 5th edition. Durham, NC: Divers Alert Network; 2009.

Divers Alert Network. Flying after diving. 2003. Available from: https://dan.org/research-reports/research-studies/flying-after-diving.

Mitchell SJ, Doolette DJ, Wachholz, CJ, Vann RD, editors. Management of mild or marginal decompression illness in remote locations. Sydney, Australia: Undersea and Hyperbaric Medical Society; 2004.

Moon RE. Treatment of decompression illness. In: Bove AA, Davis JC, editors. Bove and Davis' diving medicine, 4th edition. Philadelphia: WB Saunders; 2004. pp. 195–223.

Neuman TS, Thom SR. Physiology and medicine of hyperbaric oxygen therapy. Philadelphia, PA: Saunders; 2008.

US Navy. The Navy diving manual revision 7. USA: Carlisle Military Library; 2018.

HIGH ELEVATION TRAVEL & ALTITUDE ILLNESS

Peter Hackett, David Shlim

Typical high-elevation travel destinations include Colorado ski resorts with lodgings at 8,000–10,000 ft (≈2,440–3,050 m); Cusco, Peru (11,000 ft; ≈3,350 m); La Paz, Bolivia (12,000 ft; ≈3,650 m); Lhasa, Tibet Autonomous Region (12,100 ft; ≈3,700 m); Everest base camp, Nepal (17,700 ft; ≈5,400 m); and Mount Kilimanjaro, Tanzania (19,341 ft; ≈5,900 m). High-elevation environments expose travelers to cold, low humidity, increased ultraviolet radiation, and decreased air pressure, all of which can cause health problems. The biggest concern, however, is hypoxia, due to the decreased partial pressure of oxygen (PO_2). At 10,000 ft (≈3,050 m), for example, the inspired PO_2 is only 69% of that at sea level; acute exposure to this reduced PO_2 can lower arterial oxygen saturation to 88%–91%.

The magnitude and consequences of hypoxic stress depend on the elevation, rate of ascent, and duration of exposure; host genetic factors may also contribute. Hypoxemia is greatest during sleep; day trips to high-elevation destinations with an evening return to a lower elevation are much less stressful on the body. Because of the

key role of ventilation, travelers must avoid taking respiratory depressants at high elevations.

ACCLIMATIZATION

The human body can adjust to moderate hypoxia at elevations ≤17,000 ft (≈5,200 m) but requires time to do so. Some acclimatization to high elevation continues for weeks to months, but the acute process, which occurs over the first 3–5 days following ascent, is crucial for travelers. The acute phase is associated with a steady increase in ventilation, improved oxygenation, and changes in cerebral blood flow. Increased red cell production does not play a role in acute acclimatization, although a decrease in plasma volume over the first few days does increase hemoglobin concentration.

Altitude illness can develop before the acute acclimatization process is complete, but not afterwards. In addition to preventing altitude illness, acclimatization improves sleep, increases comfort and sense of well-being, and improves submaximal endurance; maximal exercise performance at high elevation will always be reduced compared to that at low elevation.

Travelers can optimize acclimatization by adjusting their itineraries to avoid going "too high too fast" (see Box 4-08). Gradually ascending to elevation or staging the ascent provides crucial time for the body to adjust. For example, acclimatizing for a minimum of 2–3 nights at 8,000–9,000 ft (≈2,450–≈2,750 m) before proceeding to a higher elevation is markedly protective against acute mountain sickness (AMS). The Wilderness Medical Society recommends avoiding ascent to a sleeping elevation of ≥9,000 ft (≈2,750 m) in a single day; ascending at a rate of no greater than 1,650 ft (≈500 m) per night in sleeping elevation once above 9,800 ft (≈3,000 m); and allowing an extra night to acclimatize for every 3,300 ft (≈1,000 m) of sleeping elevation gain. These reasonable recommendations can still be too fast for some travelers and annoyingly slow for others.

ALTITUDE ILLNESS

Risk to Travelers

Susceptibility and resistance to altitude illness are, in part, genetically determined traits, but there are no simple screening tests to predict risk. Training or physical fitness do not affect risk. A traveler's sex plays a minimal role, if any, in determining predisposition. Children are as susceptible as adults; people aged >50 years have slightly less risk. Any unacclimatized traveler proceeding to a sleeping elevation of ≥8,000 ft (≈2,450 m)—and sometimes lower—is at risk for altitude illness. In addition, travelers who have successfully adjusted to one elevation are at risk when moving to higher sleeping elevations, especially if the elevation gain is >2,000–3,000 ft (600–900 m).

How a traveler previously responded to high elevations is the most reliable guide for future trips, but only if the elevation and rate of ascent are similar, and even then, this is not an infallible predictor. In addition to underlying, inherent baseline susceptibilities, a traveler's risk for developing altitude illness is influenced by 3 main factors: elevation at destination, rate of ascent, and exertion (Table 4-04). Creating an itinerary to avoid any occurrence of altitude illness is difficult because of variations in individual

BOX 4-08 Acclimatization tips: a checklist for travelers

- ☐ Ascend gradually.
- ☐ Avoid going directly from low elevation to >9,000 ft (2,750 m) sleeping elevation in 1 day.
- ☐ Once above 9,000 ft (≈2,750 m), move sleeping elevation by no more than 1,600 ft (≈500 m) per day, and plan an extra day for acclimatization every 3,300 ft (≈1,000 m).
- ☐ Consider using acetazolamide to speed acclimatization if abrupt ascent is unavoidable.
- ☐ Avoid alcohol for the first 48 hours at elevation.
- ☐ If a regular caffeine user, continue using to avoid a withdrawal headache that could be confused with an altitude headache.
- ☐ Participate in only mild exercise for the first 48 hours at elevation.
- ☐ A high-elevation exposure (> 9,000 ft [≈2,750 m]) for ≥2 nights, within 30 days before the trip, is useful, but closer to the trip departure is better.

Table 4-04 Risk categories for developing acute mountain sickness (AMS)

RISK CATEGORY	DESCRIPTION	PROPHYLAXIS RECOMMENDATIONS
Low	People with no prior history of altitude illness ascending to <9,000 ft (2,750 m) People taking ≥2 days to arrive at 8,200–9,800 ft (≈2,500–3,000 m), with subsequent increases in sleeping elevation <1,600 ft (≈500 m) per day, and an extra day for acclimatization every 3,300 ft (1,000 m) increase in elevation	Acetazolamide prophylaxis generally not indicated
Moderate	People with prior history of AMS ascending to 8,200–9,200 ft (≈2,500–2,800 m) elevation (or above) in 1 day People with no history of AMS ascending to >9,200 ft (2,800 m) elevation in 1 day All people ascending >1,600 ft (≈500 m) per day (increase in sleeping elevation) at elevations >9,800 ft (3,000 m), but with an extra day for acclimatization every 3,300 ft (1,000 m)	Acetazolamide prophylaxis would be beneficial and should be considered
High	People with a history of AMS ascending to >9,200 ft (≈2,800 m) in 1 day All people with a prior history of HAPE or HACE All people ascending to >11,400 ft (≈3,500 m) in 1 day All people ascending >1,600 ft (≈500 m) per day (increase in sleeping elevation) at elevations >9,800 ft (≈3,000 m), without extra days for acclimatization People making very rapid ascents (e.g., <7-day ascent of Mount Kilimanjaro)	Acetazolamide prophylaxis strongly recommended

Abbreviations: HACE, high-altitude cerebral edema; HAPE, high-altitude pulmonary edema

susceptibility, as well as in starting points and terrain. The goal for the traveler might not be to avoid all symptoms of altitude illness but to have no more than mild illness, thereby avoiding itinerary changes or the need for medical assistance or evacuation.

Destinations of Risk

Some common high-elevation destinations require rapid ascent by a non-pressurized airplane to >11,000 ft (≈3,400 m), placing travelers in a high-risk category for AMS. A common travel medicine question is whether to recommend acetazolamide for travelers when gradual or staged acclimatization is not feasible. With rates of altitude illness approaching 30%–40% in these situations, a low threshold for chemoprophylaxis is advised. In some cases (e.g., Cusco and La Paz), travelers can descend to elevations much lower than the airport to sleep for 1–2 nights and then begin their ascent, perhaps obviating the need for medication.

Itineraries along some trekking routes in Nepal, particularly Everest base camps, push the limits of many people's ability to acclimatize. Even on standard schedules, incidence of altitude illness can approach 30% at the higher elevations. Whenever possible, adding extra days to the trek can make for a more enjoyable and safer climb.

Altitude Illness Syndromes

Altitude illness is divided into 3 syndromes: acute mountain sickness (AMS), high-altitude cerebral edema (HACE), and high-altitude pulmonary edema (HAPE). Some clinicians consider high-altitude headache a separate entity because isolated headache can occur without the combined symptoms that define AMS.