ACUTE MOUNTAIN SICKNESS

AMS is the most common form of altitude illness, affecting 25% of all visitors sleeping at elevations >8,000 ft (≈2,450 m) in Colorado.

DIAGNOSIS

Diagnosis of AMS is based on a history of recent ascent to high elevation and the presence of subjective symptoms. AMS symptoms are like those of an alcohol hangover; headache is the cardinal symptom, usually accompanied by ≥1 of the following: anorexia, dizziness, fatigue, nausea, or, occasionally, vomiting. Uncommonly, AMS presents without headache. Symptom onset is usually 2–12 hours after initial arrival at a high elevation or after ascent to a higher elevation, and often during or after the first night. Preverbal children with AMS can develop loss of appetite, irritability, and pallor. AMS generally resolves within 12–48 hours if travelers do not ascend farther.

The condition is typically self-limited, developing and resolving over 1–3 days. Symptoms starting after 3 days of arrival to high elevation and without further ascent should not be attributed to AMS. AMS has no characteristic physical findings; pulse oximetry is usually within the normal range for the elevation, or slightly lower than normal.

The differential diagnosis of AMS is broad; common considerations include alcohol hangover, carbon monoxide poisoning, dehydration, drug intoxication, exhaustion, hyponatremia, and migraine. Travelers with AMS will improve rapidly with descent ≥1,000 ft (≈300 m), and this can be a useful indication of a diagnosis of AMS.

TREATMENT

Although rarely available, supplemental oxygen at 1–2 liters per minute will relieve headaches within about 30 minutes and resolve other AMS symptoms over hours. The popular small, handheld cans of compressed oxygen can provide brief relief, but contain too little oxygen (5 liters at most) for sustained improvement. Travelers with AMS but without HACE or HAPE (both described below) can remain safely at their current elevation and self-treat with non-opiate analgesics (e.g., ibuprofen 600 mg or acetaminophen 500 mg every 8 hours) and antiemetics (e.g., ondansetron 4 mg orally disintegrating tablets).

Acetazolamide speeds acclimatization and resolves AMS, but is more commonly used and better validated for use as prophylaxis. Dexamethasone is more effective than acetazolamide at rapidly relieving the symptoms of moderate to severe AMS. If symptoms worsen while the traveler is at the same elevation, or despite supplemental oxygen or medication, descent is mandatory.

HIGH-ALTITUDE CEREBRAL EDEMA

As an encephalopathy, HACE is considered "end stage" AMS. Fortunately, HACE is rare, especially at elevations <14,000 ft (≈4,300 m). HACE is often a secondary consequence of the severe hypoxemia that occurs with HAPE.

DIAGNOSIS

Unlike AMS, HACE presents with neurological findings, particularly altered mental status, ataxia, confusion, and drowsiness, similar to alcohol intoxication. Focal neurologic findings and seizures are rare in HACE; their presence should lead to suspicion of an intracranial lesion, a seizure disorder, or hyponatremia. Other considerations for the differential diagnosis include carbon monoxide poisoning, drug intoxication, hypoglycemia, hypothermia, and stroke. Coma can ensue within 24 hours of onset.

TREATMENT

In populated areas with access to medical care, HACE can be treated with supplemental oxygen and dexamethasone. In remote areas, initiate descent for anyone suspected of having HACE, in conjunction with dexamethasone and oxygen, if available. If descent is not feasible, supplemental oxygen or a portable hyperbaric device, in addition to dexamethasone, can be lifesaving. Coma is likely to ensue within 12–24 hours of the onset of ataxia in the absence of treatment or descent.

HIGH-ALTITUDE PULMONARY EDEMA

HAPE can occur by itself or in conjunction with AMS and HACE; incidence is roughly 1 per 10,000

skiers in Colorado, and ≤1 per 100 climbers at >14,000 ft (≈4,300 m).

DIAGNOSIS

Early diagnosis is key; HAPE can be more rapidly fatal than HACE. Initial symptoms include chest congestion, cough, exaggerated dyspnea on exertion, and decreased exercise performance. If unrecognized and untreated, HAPE progresses to dyspnea at rest and frank respiratory distress, often with bloody sputum. This typical progression over 1–2 days is easily recognizable as HAPE, but the condition sometimes presents only as central nervous system dysfunction, with confusion and drowsiness.

Rales are detectable in most victims. Pulse oximetry can aid in making the diagnosis; oxygen saturation levels will be at least 10 points lower in HAPE patients than in healthy people at the same elevation. Oxygen saturation values of 50%–70% are common. The differential diagnosis for HAPE includes bronchospasm, myocardial infarction, pneumonia, and pulmonary embolism.

TREATMENT

In most circumstances, descent is urgent and mandatory. Administer oxygen, if available, and exert the patient as little as possible. If immediate descent is not an option, use of supplemental oxygen or a portable hyperbaric chamber is critical.

Patients with mild HAPE who have access to oxygen (e.g., at a hospital or high-elevation medical clinic) might not need to descend to a lower elevation and can be treated with oxygen over 2–4 days at the current elevation. In field settings, where resources are limited and there is a lower margin for error, nifedipine can be used as an adjunct to descent, oxygen, or portable hyperbaric oxygen therapy. A phosphodiesterase inhibitor can be used if nifedipine is not available, but concurrent use of multiple pulmonary vasodilators is not recommended. Descent and oxygen are much more effective treatments than medication.

MEDICATIONS

Recommendations for use and dosages of medications to prevent and treat altitude illness are outlined in Table 4-05.

Acetazolamide

MECHANISM OF ACTION

When taken preventively, acetazolamide hastens acclimatization to high-elevation hypoxia, thereby reducing occurrence and severity of AMS. It also enhances recovery if taken after symptoms have developed. The drug works primarily by inducing a bicarbonate diuresis and metabolic acidosis, which stimulates ventilation and increases alveolar and arterial oxygenation. By using acetazolamide, high-elevation ventilatory acclimatization that normally takes 3–5 days takes only 1 day. Acetazolamide also eliminates central sleep apnea, or periodic breathing, which is common at high elevations, even in those without a history of sleep disorder breathing.

DOSE

An effective dose for prophylaxis that minimizes the common side effects of increased urination and paresthesia of the fingers and toes is 125 mg every 12 hours, beginning the day before ascent and continuing the first 2 days at elevation, and longer if ascent continues. Acetazolamide can also be taken episodically for symptoms of AMS, as needed. To date, the only dose studied for treatment is 250 mg (2 doses taken 8 hours apart), although the lower dosage used for prevention has anecdotally been successful. The pediatric dose is 5 mg/kg/day in divided doses, up to 125 mg, twice a day.

ADVERSE & ALLERGIC REACTIONS

Allergic reactions to acetazolamide are uncommon. Since acetazolamide is a sulfonamide derivative, cross-sensitivity between acetazolamide, sulfonamides, and other sulfonamide derivatives is possible.

Dexamethasone

Dexamethasone is effective for preventing and treating AMS and HACE and might prevent HAPE as well. Unlike acetazolamide, if the drug is discontinued at elevation before acclimatization, mild rebound can occur. Acetazolamide is preferable to prevent AMS while ascending, and dexamethasone generally should be reserved for treatment, usually as an adjunct to descent. The adult dose is 4 mg every 6 hours; rarely is it needed

Table 4-05 Recommended medication dosing to prevent & treat altitude illness

MEDICATION	INDICATION	ROUTE	DOSE
Acetazolamide	AMS, HACE prevention	PO	125 mg twice a day; 250 mg twice a day if >100 kg body weight Pediatric: 2.5 mg/kg every 12 hours, up to 125 mg
	AMS treatment	PO	250 mg twice a day[1]
Dexamethasone	AMS, HACE prevention	PO	2 mg every 6 hours or 4 mg every 12 hours Pediatric: do not use for prophylaxis
	AMS, HACE treatment	PO, IV, IM	AMS: 4 mg every 6 hours HACE: 8 mg once, then 4 mg every 6 hours Pediatric: 0.15 mg/kg/dose every 6 hours up to 4 mg
Nifedipine	HAPE prevention	PO	30 mg SR version every 12 hours or 20 mg SR version every 8 hours
	HAPE treatment	PO	30 mg SR version every 12 hours or 20 mg SR version every 8 hours
Salmeterol[2]	HAPE prevention	Inhaled	125 µg twice a day
Sildenafil	HAPE prevention	PO	50 mg every 8 hours
Tadalafil	HAPE prevention	PO	10 mg twice a day

Abbreviations: AMS, acute mountain sickness; HACE, high-altitude cerebral edema; HAPE, high-altitude pulmonary edema; IM, intramuscular; IV, intravenous; PO, by mouth; SR, sustained release.

[1]This dose can also be used as an adjunct to dexamethasone for HACE treatment; dexamethasone remains the primary treatment for HACE.

[2]Use only in conjunction with oral medications and not as monotherapy for HAPE prevention.

for more than 1–2 days. An increasing trend is to use dexamethasone for "summit day" on high peaks (e.g., Aconcagua and Kilimanjaro) to prevent abrupt altitude illness.

Ibuprofen

Recent studies have shown that taking ibuprofen 600 mg every 8 hours helps prevent AMS, although not quite as effectively as acetazolamide. Ibuprofen is, however, available over the counter, inexpensive, and well tolerated.

Nifedipine

Nifedipine both prevents and ameliorates HAPE. For prevention, nifedipine is generally reserved for people who are particularly susceptible to the condition. The adult dose for prevention or treatment is 30 mg of extended release every 12 hours, or 20 mg every 8 hours.

Phosphodiesterase-5 Inhibitors

Phosphodiesterase-5 inhibitors selectively lower pulmonary artery pressure, with less effect on systemic blood pressure than nifedipine. Tadalafil, 10 mg taken twice a day during ascent, can prevent HAPE. It is also being studied as a possible treatment.

PREVENTING SEVERE ALTITUDE ILLNESS OR DEATH

The main point of instructing travelers about altitude illness is not to eliminate the possibility of

mild illness but to prevent death or evacuation. Because the onset of symptoms and the clinical course are sufficiently slow and predictable, there is no reason for anyone to die from altitude illness unless they are trapped by weather or geography in situations where descent is impossible. Travelers can adhere to 3 rules to help prevent death or serious consequences from altitude illness:

- Know the early symptoms of altitude illness and be willing to acknowledge when symptoms are present.
- Never ascend to sleep at a higher elevation when experiencing symptoms of altitude illness, no matter how minor the symptoms seem.
- Descend if the symptoms become worse while resting at the same elevation.

For trekking groups and expeditions going into remote high-elevation areas, where descent to a lower elevation could be problematic, a pressurization bag (e.g., the Gamow bag) can be beneficial. A foot pump produces an increased pressure of 2 lb/in^2, mimicking a descent of 5,000–6,000 ft (≈1,500–1,800 m) depending on the starting elevation. The total packed weight of bag and pump is about 14 lb (6.5 kg).

Preexisting Medical Conditions

Travelers with preexisting medical conditions must optimize their treatment and have their conditions stable before departure. In addition, these travelers should have plans for dealing with exacerbation of their conditions at high elevations. Travelers with underlying medical conditions (e.g., coronary artery disease, any form of chronic pulmonary disease or preexisting hypoxemia, obstructive sleep apnea [OSA], or sickle cell trait)—even if well controlled—should consult a physician familiar with high-elevation medical issues before undertaking such travel (Table 4-06).

Table 4-06 Ascent risk associated with various underlying medical conditions & risk factors

LIKELY NO EXTRA RISK	CAUTION REQUIRED[1]	ASCENT CONTRAINDICATED
Asthma (well-controlled)	Angina (stable)	Angina (unstable)
Children and adolescents	Arrhythmias (poorly controlled)	Asthma (unstable, poorly controlled)
Chronic obstructive pulmonary disease (mild)	Chronic obstructive pulmonary disease (moderate)	Cerebral space–occupying lesions
Coronary artery disease (following revascularization)	Cirrhosis	Cerebral vascular aneurysms or arteriovenous malformations (untreated, high-risk)
Diabetes mellitus	Coronary artery disease (nonrevascularized)	Chronic obstructive pulmonary disease (severe/very severe)
Elderly	Cystic fibrosis (FEV_1 30%–50% predicted)	Cystic fibrosis (FEV_1 <30% predicted)
Hypertension (controlled)	Heart failure (compensated)	Heart failure (decompensated)
Neoplastic diseases	Hypertension (poorly controlled)	Myocardial infarction or stroke (<90 days before ascent)
Obesity (Class 1/Class 2)[2]	Infants <6 weeks old	Pregnancy (high-risk)
Obstructive sleep apnea (mild/moderate)	Obesity (Class 3)[3]	Pulmonary hypertension (pulmonary artery systolic pressure >60 mm Hg)
Pregnancy (low-risk)	Obstructive sleep apnea (severe)	Sickle cell anemia
Psychiatric disorders (stable)	Pulmonary hypertension (mild)	
Sedentary	Radial keratotomy surgery	
Seizure disorder (controlled)	Seizure disorder (poorly controlled)	
	Sickle cell trait	

Abbreviations: FEV_1, forced expiratory volume in 1 second

[1]Travelers with these conditions most often require consultation with a physician experienced in high-altitude medicine and a comprehensive management plan.
[2]Class 1 obesity: Body Mass Index (BMI) of 30 to <35; Class 2 obesity: BMI of 35 to <40.
[3]Class 3 obesity: BMI of ≥40.

Clinicians advising travelers should know that in most high-elevation resorts and cities, "home" oxygen is readily available. In North America, this requires a prescription that the traveler can carry, or oxygen can be arranged beforehand. Supplemental oxygen, whether continuous, episodic, or nocturnal, depending on the circumstances, is very effective at restoring oxygenation to low elevation values and eliminates the risk for altitude illness and exacerbation of preexisting medical conditions.

DIABETES MELLITUS

Travelers with diabetes can travel safely to high elevations, but they must be accustomed to exercise if participating in strenuous activities at elevation and carefully monitor their blood glucose. Diabetic ketoacidosis can be triggered by altitude illness and can be more difficult to treat in people taking acetazolamide. Not all glucose meters read accurately at high elevations.

OBSTRUCTIVE SLEEP APNEA

Travelers with sleep disordered breathing who are planning high-elevation travel should receive acetazolamide. Those with mild to moderate OSA who are not hypoxic at home might do well without a continuous positive airway pressure (CPAP) device, while those with severe OSA should be advised to avoid high-elevation travel unless they receive supplemental oxygen in addition to their CPAP. Oral appliances for OSA can be useful adjuncts when electrical power is unavailable.

PREGNANCY

There are no studies or case reports describing fetal harm among people who briefly travel to high elevations during their pregnancy. Nevertheless, clinicians might be prudent to recommend that pregnant people do not stay at sleeping elevations >10,000 ft (≈3,050 m). Travel to high elevations during pregnancy warrants confirmation of good maternal health and verification of a low-risk gestation. Advise pregnant travelers of the dangers of having a pregnancy complication in remote, mountainous terrain.

RADIAL KERATOTOMY

Most people do not have visual problems at high elevations. At very high elevations, however, some people who have had radial keratotomy procedures might develop acute farsightedness and be unable to care for themselves. LASIK and other newer procedures may produce only minor visual disturbances at high elevations.

BIBLIOGRAPHY

Bartsch P, Swenson ER. Acute high-altitude illnesses. N Engl J Med. 2013;369(17):1666–7.

Hackett PH, Luks AM, Lawley JS, Roach RC. High-altitude medicine and pathophysiology. In: Auerbach PS, editor. Wilderness medicine, 7th edition. Philadelphia: Elsevier; 2017. pp. 8–28.

Hackett PH, Roach RC. High altitude cerebral edema. High Alt Med Biol. 2004;5(2):136–46.

Luks AM, Auerbach PS, Freer L, Grissom CK, Keyes LE, McIntosh SE, et al. Wilderness Medical Society clinical practice guidelines for the prevention and treatment of acute altitude illness: 2019 update. Wilderness Environ Med. 2019;30(4S):S3–18.

Luks AM, Hackett PH. High altitude and preexisting medical conditions. In: Auerbach PS, editor. Wilderness medicine, 7th edition. Philadelphia: Elsevier; 2017. pp. 29–39.

Luks AM, Hackett PH. Medical conditions and high-altitude travel. N Engl J Med. 2022;386(4):364–73.

Luks AM, Swenson ER. Medication and dosage considerations in the prophylaxis and treatment of high-altitude illness. Chest. 2008;133(3):744–55.

Meier D, Collet TH, Locatelli I, Cornuz J, Kayser B, Simel DL, Sartori C. Does this patient have acute mountain sickness? The rational clinical examination systematic review. JAMA. 2017;318(18):1810–19.

Roach RC, Lawley JS, Hackett PH. High-altitude physiology. In: Auerbach PS, editor. Wilderness medicine, 7th edition. Philadelphia: Elsevier; 2017. pp. 2–8.

Woolcott OO. The Lake Louise Acute Mountain Sickness score: still a headache. High Alt Med Biol. 2021;22(4):351–2.

MOSQUITOES, TICKS & OTHER ARTHROPODS

John-Paul Mutebi, John Gimnig

Vectorborne diseases are found at almost every travel destination. Because few vaccines are available to protect travelers, the best way to prevent vectorborne diseases is to avoid being bitten by ticks and insects, including mosquitoes, fleas, chiggers, and flies, that transmit pathogens that cause disease. Travel health practitioners should advise travelers to use repellents and take other precautions to prevent bites.

VACCINE OPTIONS & MALARIA PROPHYLAXIS

Vaccines are currently available to protect against 3 vectorborne diseases in US travelers: Japanese encephalitis, tick-borne encephalitis, and yellow fever (see the respective chapters in Section 5 for details). No vaccines or prophylactic drugs are available in the United States for other mosquitoborne diseases (e.g., chikungunya, filariasis, West Nile encephalitis, Zika); tick-borne diseases (e.g., Lyme borreliosis, relapsing fever); sand fly–borne diseases (e.g., cutaneous or visceral leishmaniasis); or blackfly–borne diseases (e.g., onchocerciasis [river blindness]).

In June 2021, Dengvaxia was recommended by the Advisory Committee on Immunization Practices (ACIP) to prevent dengue in children aged 9–16 years who had laboratory-confirmed previous dengue virus infection and who live in dengue-endemic areas. Dengue is endemic to the US territories of American Samoa, Puerto Rico, and US Virgin Islands, and to freely associated states including the Federated States of Micronesia, the Republic of Marshall Islands, and the Republic of Palau. The dengue vaccine will not be available for use in travelers not living in dengue-endemic areas in the US territories, however.

Prophylactic drugs are available to protect against malaria; however, the effectiveness of malaria prophylaxis is variable, depending on patterns of drug resistance, bioavailability, individual behavior, and compliance with medication (see Sec. 2, Ch. 5, Yellow Fever Vaccine & Malaria Prevention Information, by Country, and www.cdc.gov/malaria/travelers/country_table/a.html).

INSECT REPELLENTS

When used as directed, insect repellents registered by the Environmental Protection Agency (EPA) have been proven safe and effective, even for pregnant and breastfeeding people. The Centers for Disease Control and Prevention (CDC) has evaluated information published in peer-reviewed scientific literature and data available from EPA to identify several types of EPA-registered products that safely and effectively prevent insect bites. Products containing the following active ingredients typically provide reasonably long-lasting protection:

DEET (chemical name: N,N-diethyl-m-toluamide or N,N-diethyl-3-methyl-benzamide). Products containing DEET include, but are not limited to, Off!, Cutter, Sawyer, and Ultrathon.

PICARIDIN (KBR 3023 [Bayrepel] and icaridin outside the United States; chemical name: 2-[2-hydroxyethyl]-1-piperidinecarboxylic acid 1-methylpropyl ester). Products containing picaridin include, but are not limited to, Cutter Advanced, Skin So Soft Bug Guard Plus, and Autan (outside the United States).

OIL OF LEMON EUCALYPTUS (OLE) or **PMD** (chemical name: para-menthane-3,8-diol, the synthesized version of OLE). Products containing OLE and PMD include, but are not limited to, Repel and Off! Botanicals. CDC does not recommend using "pure" oil of lemon eucalyptus (an essential oil that is not formulated) as a repellent, because it has not undergone validated testing for safety and efficacy and is not registered with EPA as an insect repellent. In general, parents should not use products containing OLE or PMD

on children <3 years old to avoid potential allergic skin reactions.

IR3535 (chemical name: 3-[N-butyl-N-acetyl]-aminopropionic acid, ethyl ester). Products containing IR3535 include, but are not limited to, Skin So Soft Bug Guard Plus Expedition and SkinSmart.

2-UNDECANONE (chemical name: methyl nonyl ketone). The product BioUD contains 2-undecanone.

EPA characterizes the active ingredients DEET and picaridin as "conventional" repellents. The biopesticide repellents (OLE, PMD, IR3535, and 2-undecanone) are derived from, or are synthetic versions of, natural materials.

Travelers can find the right insect repellent for their needs by searching the EPA website Find the Repellent that is Right for You (www.epa.gov/insect-repellents/find-repellent-right-you) and the National Pesticide Information Center website, Choosing and Using Insect Repellents (http://npic.orst.edu/ingred/ptype/repel.html). Recommendations from these websites are based on peer-reviewed journal articles and scientific studies and data submitted to regulatory agencies.

Ideally, travelers should purchase repellents before departing the United States. A wide variety of repellents are available at camping, sporting goods, and military surplus stores. When purchasing repellents overseas, travelers should look for the active ingredients specified above on the product labels; some names of products available internationally also are provided above.

Efficacy

Published data indicate that repellent efficacy and duration of protection vary considerably among products and among arthropod species. Product efficacy and duration of protection are also markedly affected by ambient temperature, level of activity, amount of perspiration, exposure to water, being rubbed off during activities, and other factors.

In general, higher concentrations of active ingredients provide longer duration of protection, regardless of the active ingredient. Products with <10% active ingredient might offer only limited protection, often 1–2 hours. Products that offer sustained-release or controlled-release (microencapsulated) formulations, even with lower active ingredient concentrations, might provide longer protection times. Studies suggest that DEET efficacy tends to peak at a concentration of ≈50%, and that concentrations above that do not offer a marked increase in protection time against mosquitoes. Regardless of the product used, if travelers start getting bitten they should reapply, but not more often than the label allows.

The effectiveness of non–EPA-registered insect repellents, including some natural repellents, is unknown, and travelers should avoid using them (see www.epa.gov/insect-repellents).

Repellents & Sunscreen

Repellents applied according to label instructions can be used with sunscreen with no reduction in repellent activity. However, limited data show that DEET-containing insect repellents applied over sunscreen decrease the sun protection factor (SPF) of the sunscreen by one-third.

Travelers should avoid products that combine sunscreen with repellents because sunscreen might need to be reapplied more often and in larger amounts than what is needed for the repellent component to provide protection from biting insects. In general, travelers should use separate products, apply sunscreen first, and then apply the repellent. Because SPF decreases when a DEET-containing insect repellent is used, travelers might need to reapply sunscreen more frequently. Travelers must remember to use both sunscreen and insect repellents according to the manufacturer's instructions for each.

Use on Clothing & Gear

Travelers can treat clothing, hats, shoes, mosquito nets, outwear, and camping gear with permethrin for added protection. Permethrin is a highly effective insecticide, acaricide (pesticide that kills ticks and mites), and repellent. At a concentration of 0.5%, permethrin-treated clothing repels and kills ticks, chiggers, mosquitoes, and other biting and nuisance arthropods. Clothing and other items must be treated 24–48 hours before packing for travel to allow them to dry. As with all pesticides, travelers should always follow the label instructions.

Products such as Permanone and Sawyer, Permethrin, Repel, and Ultrathon Permethrin

Clothing Treatment are registered with the EPA specifically for use by consumers to treat clothing and gear. Alternatively, clothing pretreated with permethrin is commercially available and marketed to consumers in the United States as Insect Shield, BugsAway, or Insect Blocker.

Permethrin-treated materials retain repellency or insecticidal activity after repeated launderings, but should be retreated as described on the product label to provide continued protection. Clothing treated before purchase is labeled for efficacy through many launderings. Clothing treated with the other repellent products described above (e.g., DEET) provides protection from biting arthropods but will not last through washing and will require more frequent application.

Precautions

Box 4-09 contains precautions clinicians can share with travelers regarding the use of insect repellents. Severe reactions to insect repellents are rare. If a traveler experiences a rash or other reaction (e.g., itching, swelling) from a repellent, they should wash off the product using mild soap and water and discontinue its use. Travelers seeking health care because of a reaction to a repellent should take the product container with them to the doctor's office. Reactions associated with insect repellent use are outlined in MedlinePlus (https://medlineplus.gov/ency/article/002763.htm).

Permethrin should never be applied to the skin but only to clothing, mosquito nets, or other fabrics as directed on the product label.

Children & Pregnant People

Certain insect repellent products containing OLE as their sole active ingredient at concentrations of ≤30% can be used on children <3 years of age; parents should always read the product label before use. Insect repellents containing DEET, Picaridin, IR3535, and 2-undecanone can be used on children without age restriction (see www.epa.gov/insect-repellents/using-insect-repellents-safely-and-effectively#children). Travelers can protect infants from insect bites by dressing them in clothing that covers their arms and legs, by covering strollers and baby carriers with mosquito netting, and by using appropriate insect repellent. Other than the safety tips listed above, EPA does not recommend any additional precautions for using registered repellents on children or on people who are pregnant or lactating.

INSECT BITE PREVENTION

Travelers can reduce their risk for bites from mosquitoes, ticks, fleas, sand flies, and other arthropods by using EPA-registered insect repellents. Travelers should also minimize areas of exposed skin by wearing long-sleeved shirts, long pants, boots, and hats. Tucking in shirts, tucking pants into socks, and wearing closed shoes instead of

BOX 4-09 Precautions when using insect repellents: guidance for travelers

Apply repellents only to exposed skin or clothing, as directed on the product label. Do not apply to skin covered by clothing.

Never use repellents on cuts, wounds, or irritated skin.

When using sprays, do not spray directly on the face—spray product on hands first and then apply to face. Do not apply to eyes or mouth; apply only sparingly around ears.

Wash hands after application to avoid accidental ingestion or exposure to eyes.

Children should not handle repellents. Instead, adults should apply repellent to their own hands first and then gently spread product on the child's exposed skin. Avoid applying repellents to children's hands. After returning indoors, wash children's treated skin and clothing with soap and water or give the child a bath.

Use just enough repellent to cover exposed skin or clothing. Heavy application and saturation are generally unnecessary for effectiveness. If biting insects do not respond to a thin film of repellent, apply a bit more.

After returning indoors, wash repellent-treated skin with soap and water, or bathe.

Follow instructions on the product label for handling repellent-treated clothing.

sandals also might help reduce risk. Application of repellents or insecticides (e.g., 0.5% permethrin) to clothing and gear can provide an added layer of protection. Remind travelers to always follow instructions on the label when applying repellents or insecticides. Additional prevention techniques are provided below.

Mosquitoes

More than 3,000 different mosquito species live worldwide, and each has specific biting behaviors; some species have local and regional variations, meaning biting behaviors might not be uniform throughout the distribution range of a specific species. Mosquitoes bite throughout the day and night, although each species tends to have peak activity at certain times.

The peak biting activity of *Aedes aegypti* (the primary vector for chikungunya, dengue, Mayaro, yellow fever, and Zika) is after sunrise (dawn) and at sunset (dusk). By contrast, peak biting activity for *Culex quinquefasciatus* (a vector for filariasis; Japanese, St. Louis, and West Nile encephalitis; and Usutu) is typically after sunset, usually between 10–11 p.m. The biting activity of *Anopheles* mosquitoes, the primary vectors for malaria worldwide, varies with the species. Peak biting activity for *Anopheles gambiae*, for example, the primary malaria vector in Africa, is between 3–6 a.m. Peak biting activity for *Anopheles albimanus*, an important malaria vector in Central and South America, is between 10–11 p.m.

Avoiding peak biting activity periods minimizes the chances of vectorborne disease. Although some mosquito species can roughly be described as day-biters and others as nocturnal feeders, regional variations and overlap in feeding times means that travelers need to be cautious about mosquito bites at all times of day and night in regions where mosquito-borne diseases are a risk.

As much as possible, travelers should avoid visiting areas with active outbreaks of mosquito-borne diseases. The CDC Travelers' Health website (https://wwwnc.cdc.gov/travel/) provides updates on regional disease transmission patterns and outbreaks. For more on mosquito bite prevention techniques, see Prevent Mosquito Bites (www.cdc.gov/mosquitoes/mosquito-bites/prevent-mosquito-bites.html).

SPATIAL REPELLENTS

Spatial repellents, including aerosol insecticide sprays, vaporizing mats, and mosquito coils, contain active ingredients (e.g., metofluthrin, allethrin) people can use to protect against insect bites. Spray aerosols can help clear mosquitoes from larger spaces, while coils and spatial repellents repel mosquitoes from more circumscribed areas.

Although many of these products have repellent or insecticidal activity under certain conditions, they have not yet been adequately evaluated in peer-reviewed studies for efficacy in preventing vectorborne diseases. Travelers should supplement use of these products with an EPA-registered repellent on skin or clothing and by using mosquito nets in areas where vectorborne diseases are a risk or biting arthropods are noted.

Some products available internationally might contain pesticides that are not registered for use in the United States. Conversely, travelers intending to bring their own spatial repellents should make sure the repellents are legal for use at their destination. Travelers should consult the US embassy website in the destination country. Advise travelers to use spatial repellents with caution and to avoid direct inhalation of spray or smoke.

Ticks

Hiking, camping, and hunting are examples of activities that could bring travelers in close contact with ticks. Travelers should avoid wooded and brushy areas with high grass and leaf litter, and stay in the center of hiking trails. For more on tick bite prevention techniques, see Preventing Tick Bites (www.cdc.gov/ticks/avoid/on_people.html).

Figure 4-01 provides instructions on how to remove attached ticks. Counsel travelers who develop rash or fever within several weeks of removing a tick to see a doctor; travelers should

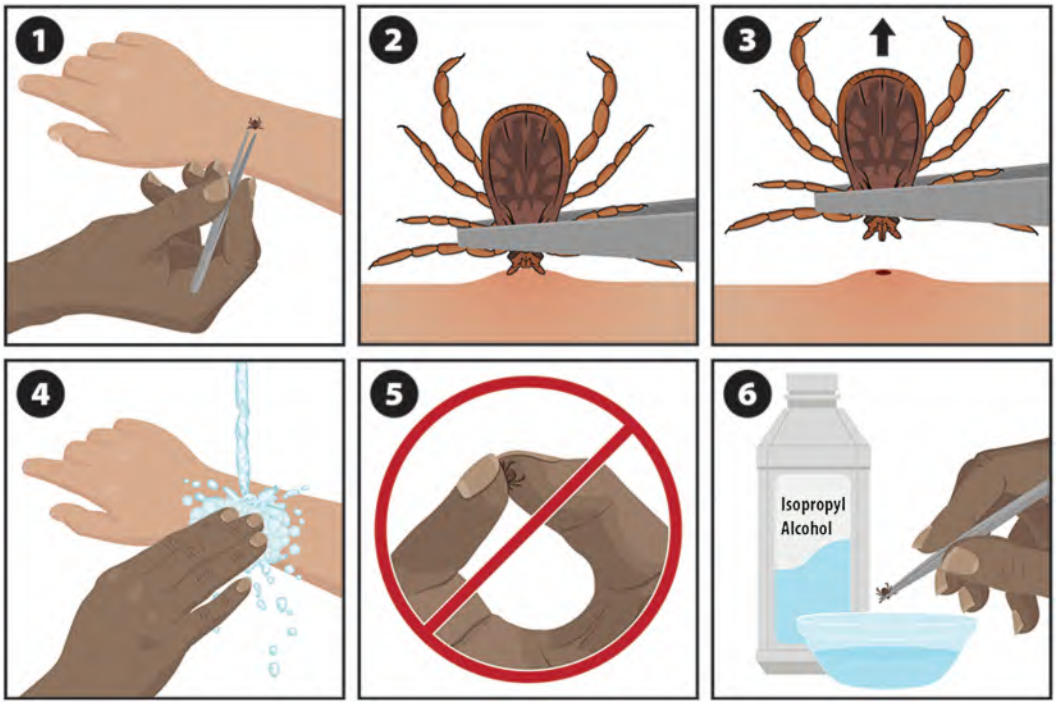


FIGURE 4-01 How to remove a tick: instructions for travelers

If a tick is attached to the skin, remove it as soon as possible.
Several tick removal devices are available on the market, but a plain set of fine-tipped tweezers work very well.
Using fine-tipped tweezers, grasp the tick as close to the surface of the skin as possible.
Pull upward with steady, even pressure without twisting or jerking the tick; twisting or jerking can cause the mouthparts of the tick to break off in the skin.
If the mouthparts of the tick break off in the skin, and they can be removed easily, remove them with tweezers.
If the mouthparts cannot be removed easily, leave them alone and allow the skin to heal.
After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water.
Never crush a tick with your fingers.
Dispose of live ticks by placing them in alcohol or a sealed bag/container, wrapping them tightly with tape, or flushing them down the toilet.

provide details (if known) about the bite, including when and where it occurred.

Fleas

Flea bites often occur on the lower legs and feet. Travelers can protect these areas of the body by wearing long socks and pants. In addition, travelers should not feed or pet stray or wild animals. For more on flea bite prevention techniques, see Preventing Flea Bites (www.cdc.gov/fleas/avoid/on_people.html). For more on the importance of avoiding animals while traveling, see Sec. 4, Ch. 7, Zoonotic Exposures: Bites, Stings, Scratches & Other Hazards.

Sand Flies

Sand flies are most active during dawn and dusk. If possible, travelers should limit outdoor activities during those times.

BED BUGS

Bed bugs have not been shown to transmit disease to humans. A recent surge in bed bug infestations worldwide, particularly in high-income countries, is thought to be related to international travel, changes in pest control strategies in travel lodgings, and insecticide resistance. Bed bug infestations have been reported in hotels, theaters, and locations where people

BOX 4-10 Recommended protective measures to avoid or reduce bed bug exposure

INSPECT THE PREMISES

Look carefully for bed bugs on mattresses, box springs, bedding, and furniture, particularly built-in furniture with the bed, desk, and closets as a continuous structural unit. Bed bug eggs and nymphs are very small and can be easily overlooked.

SEEK ALTERNATIVE LODGING

Travelers who observe evidence of bed bug activity—whether it be the bugs themselves or physical signs (e.g., blood-spotting on linens)—should seek alternative lodging.

PRACTICE LUGGAGE PRECAUTIONS

Keep suitcases off the floor. Keep suitcases closed when not in use. Remove clothing and needed items (e.g., toiletry bags and shaving kits) from the suitcase only as necessary. Carefully inspect all clothing and other items before returning them to the suitcase.

congregate, even in the workplace, dormitories, and schools.

Bed bugs are small, flat insects that are reddish-brown in color, wingless, and range from 1–7 mm in length. Bed bug bites can produce strong allergic reactions and considerable emotional stress. Bed bugs can be transported in luggage and on clothing and by transporting personal belongings in contaminated transport vehicles.

Travelers can take measures to avoid bed bug bites and avoid transporting them in luggage and clothing (Box 4-10). Prevention is by far the most effective and inexpensive way to protect oneself from these pests. The cost associated with ridding a personal residence of bed bugs is considerable, and efforts at controlling bed bugs are often not immediately successful, even when conducted by professionals.

BIBLIOGRAPHY

Barnard DR, Xue RD. Laboratory evaluation of mosquito repellents against *Aedes albopictus*, *Culex nigripalpus*, and *Ochlerotatus triseriatus* (Diptera: Culicidae). J Med Entomol. 2004;41(4):726–30.

Fradin MS, Day JF. Comparative efficacy of insect repellents against mosquito bites. N Engl J Med. 2002;347(1):13–8.

Goodyer LI, Croft AM, Frances SP, Hill N, Moore SJ, Onyango SP, et al. Expert review of the evidence base for arthropod bite avoidance. J Travel Med. 2010;17(3):182–92.

Lupi E, Hatz C, Schlagenhauf P. The efficacy of repellents against *Aedes*, *Anopheles*, *Culex* and *Ixodes* spp.—a literature review. Travel Med Infect Dis. 2013;11(6):374–411.

Montemarano AD, Gupta RK, Burge JR, Klein K. Insect repellents and the efficacy of sunscreens. Lancet. 1997;349(9066):1670–1.

Murphy ME, Montemarano AD, Debboun M, Gupta R. The effect of sunscreen on the efficacy of insect repellent: a clinical trial. J Am Acad Dermatol. 2000;43(2 Pt 1):219–22.

Pages F, Dautel H, Duvallet G, Kahl O, de Gentile L, Boulanger N. Tick repellents for human use: prevention of tick bites and tick-borne diseases. Vector Borne Zoonotic Dis. 2014;14(2): 85–93.

Strickman D, Frances, SP, Debboun M. Prevention of bug bites, stings, and disease. Florida Entomologist. 2009;92(4):677–8.

US Environmental Protection Agency. Using insect repellents safely and effectively. Available from: www.epa.gov/insect-repellents/using-insect-repellents-safely-and-effectively.

ZOONOTIC EXPOSURES: BITES, STINGS, SCRATCHES & OTHER HAZARDS

Kendra Stauffer, Ryan Wallace, G. Gale Galland, Nina Marano

International travelers might encounter familiar animals (e.g., dogs and cats) that demonstrate unfamiliar behavior, and unfamiliar animals that can be venomous, toxic, or aggressive. People coming from areas where dangerous reptiles do not exist, for example, do not necessarily recognize the risk posed when they visit places where reptiles can threaten human health.

Animals do not have to be sick to be a risk to humans. The normal flora of poultry, reptiles, and ruminants can cause serious infections in humans, and rodents, bats, and nonhuman primates can be carriers of disease. Any animal (domestic or wild) can attack if it feels threatened, is protecting its young or territory, or is injured or ill. Free-roaming (stray) dogs are also common in many destinations and do not behave like pet dogs. Travelers should be aware that attacks by domestic animals are far more common than attacks by wildlife, and secondary infections of wounds can result in serious illness or death. Table 4-07 highlights groups of animals that are common reservoirs and routes of transmission of zoonotic diseases.

BITES & SCRATCHES

Bites from certain mammals encountered during foreign travel (bats, cats, dogs, monkeys, and rodents) present a risk for serious infection. Saliva from these animals can be contaminated so heavily with pathogens that a bite might not be required to cause human infection, and exposures can occur through cuts, scratches, or mucous membranes. For example, a 60-year-old man visiting Morocco was scratched on the face by a dog, became sick with rabies, and died.

Prevention

ANIMAL ADOPTION

Travelers should avoid the temptation to adopt stray animals from abroad, because the animals' medical history often is unknown, behavioral screening is incomplete or inaccurate, and the animal might be infected or incubating a disease not found in the United States. See Sec. 4, Ch. 9, Bringing Animals & Animal Products into the United States, for more details.

ANIMAL AVOIDANCE

Advise travelers to never pet, handle, or feed unfamiliar animals, domestic or wild, even in captive settings (e.g., game ranches, petting zoos), particularly in areas where rabies is enzootic. Safaris and ecotours may encourage up-close contact with animals; these animals are wild, however, often have unpredictable behavior, and associate humans with food. Travelers should exercise caution to avoid bites, scratches, and exposure to infectious materials.

Animals in some areas have learned that plastic or paper lunch bags, often placed in backpacks, are a food source. Monkeys are notorious for climbing into vehicles and opening backpacks to get food. Remind travelers to keep food items separated from personal effects in the vehicle. Travelers also should remove shiny or flashy jewelry, because these can attract attention from monkeys. Monkey bites are common in India, Thailand, Indonesia, and Bali, and most injuries occur when people try to touch or feed these animals.

When navigating cities, travelers should move wide around corners or blind spots, and check under restaurant tables, food stalls, and parked

Table 4-07 Animal reservoirs & mechanisms / routes of human exposure to zoonotic diseases & pathogens[1]

ANIMAL RESERVOIR	BITES & SCRATCHES	INHALATION & INGESTION
Bats	**BACTERIAL**	
		Leptospira spp. *Pasteurella* spp. Salmonellosis Yersiniosis
	VIRAL	
	Rabies	>200 bat-associated viruses (almost all RNA) Hemorrhagic fever viruses Paramyxoviruses (parainfluenza type 2 virus, Mapuera, Menangle, Nipah, Hendra) Coronaviruses (SARS-CoV-1, SARS-CoV-2, MERS)
	FUNGAL	
		Blastomycosis Cryptococcosis Histoplasmosis
Birds	**BACTERIAL**	
	Psittacosis	Avian mycobacteriosis Psittacosis Salmonellosis
	VIRAL	
		Avian influenza (highly pathogenic) in humans
	FUNGAL	
		Histoplasmosis
Cats & dogs	**BACTERIAL**	
	Capnocytophaga canimorsus Plague Tularemia	*Bartonella* spp. *Brucella* spp. *Campylobacter* spp. *Leptospira* spp. *Pasteurella* spp.
	VIRAL	
	Rabies	

Table 4-07 Animal reservoirs & mechanisms / routes of human exposure to zoonotic diseases & pathogens (continued)

ANIMAL RESERVOIR	BITES & SCRATCHES	INHALATION & INGESTION
Monkeys	**BACTERIAL**	
		Campylobacter spp. Salmonellosis Shigellosis
	VIRAL	
	B virus Rabies Simian retroviruses	
Rodents	**BACTERIAL**	
		Leptospira spp.[2] Salmonellosis[2]
	VIRAL	
	Lymphocytic choriomeningitis virus Monkeypox Rat-bite fever Viral hemorrhagic fevers	Arenavirus[2] Hantavirus[2] Hemorrhagic fever with renal syndrome[2] Lassa fever[2] Lymphocytic choriomeningitis virus[2] Monkeypox[3] Viral hemorrhagic fevers[2]
Rodent fleas, ticks & mites	**BACTERIAL**	
	Bartonella spp. Lyme disease Plague Rickettsial infections Tularemia	
	VIRAL	
	Tick-borne encephalitis	

[1]See Healthy Pets, Healthy People: Diseases That Can Spread Between Animals and People (www.cdc.gov/healthypets/diseases/index.html).
[2]Transmitted through inhalation or ingestion of rodent feces or urine.
[3]Transmitted through direct rodent contact.

vehicles, because cats, dogs, and monkeys tend to rest in these places. Startling one of these animals might result in a bite or scratch. Advise parents traveling with young children to watch them carefully around unfamiliar animals, because children are more likely to be bitten or scratched and to sustain more severe injuries.

PRETRAVEL VACCINES

Before departure, travelers should have a current tetanus vaccination or documentation of a booster vaccination in the previous 10 years (see Sec. 5, Part 1, Ch. 21, Tetanus). Travel health providers also should assess a traveler's need for preexposure rabies vaccine (see Sec. 5, Part 2, Ch. 18, Rabies).

Management

HIGH-RISK EXPOSURES

A high-risk exposure is an animal bite or scratch that was unprovoked or that came from an animal that appeared ill. Provoked bites and scratches are often inflicted when a person attempts to feed or handle an otherwise healthy-appearing animal. Unprovoked bites and scratches increase the likelihood that the animal might be sick and possibly infectious for certain zoonotic diseases (e.g., rabies). Travelers with high-risk exposures should seek professional medical care immediately, and not wait until they return to their home country.

B VIRUS

If bitten or scratched by a monkey, travelers should be evaluated for B virus postexposure prophylaxis (PEP; see Sec. 5, Part 2, Ch. 1, B Virus). B virus is enzootic in macaque monkeys (e.g., crab-eating macaques, rhesus macaques) found in North Africa and Gibraltar, and in Asia. Although B virus infections in humans are rare, and no reports of infection in travelers have been documented, the death rate in infected humans is high. Travelers should properly clean the wound after being bitten; prophylactic antiviral treatment with acyclovir or ganciclovir might be indicated in some cases.

RABIES

A health care professional should evaluate travelers bitten or scratched by any animal to assess the need for rabies PEP (see Sec. 5, Part 2, Ch. 18, Rabies). If a suspected rabies exposure has occurred, travelers should stop their journey and travel to a reliable place where they can obtain appropriate PEP; this could require traveling to another country. During the pretravel consultation, suggest countries where PEP is available and most accessible (see www.cdc.gov/rabies/resources/countries-risk.html).

Rabies exposures are relatively common among travelers and are positively correlated with length of stay. One study estimated travelers' rabies exposure incidence at 0.4% per month of stay, and other studies have shown that most exposures occur within the first 2 weeks of travel, indicating that even short-term travel can pose a risk for exposure.

Bats, a reservoir for rabies and rabies-related viruses globally, have very small, sharp teeth that might not leave discernable bite marks; travelers might not recognize or might trivialize bat exposure and not seek care. In many countries, bats, cats, dogs, and terrestrial carnivores are the most commonly reported rabid animals. Rabies is comparatively rare in primates and rodents. Rodent exposures should not constitute a rabies exposure with very rare exceptions.

TETANUS

Travelers with high-risk exposures, including animal bites and scratches, who were not recently vaccinated for tetanus will require a dose of tetanus toxoid–containing vaccine (Tdap, Td, or DTaP). This applies to people who received their most recent tetanus toxoid–containing vaccine >5 years before their exposure and to people who have not received ≥3 doses of tetanus toxoid–containing vaccines (see Sec. 5, Part 1, Ch. 21, Tetanus).

WOUND CARE

If a traveler receives a bite or scratch wound, they should clean the wound as soon as possible by washing with soap and running water for ≥20 minutes to prevent infections (e.g., B virus, rabies). Where possible, health care professionals should promptly clean and debride wounds contaminated with necrotic tissue, dirt, or other foreign materials. Often, a course of antibiotics is appropriate after animal bites or scratches because such wounds can lead to local or systemic infections. Some bite or scratch wounds might need to be left open to heal by secondary intention.

STINGS & ENVENOMATIONS

Snakes, insects, marine fish, and invertebrates are hazards to humans in many locations. Snakebites usually occur in areas where human populations coexist with dense snake populations (e.g., Southeast Asia, sub-Saharan Africa, Australia, tropical areas in the Americas). Of the 3,000 species of snakes, 600 species are venomous, and only 200 species can kill or significantly wound a human. One study showed that 25%–40% of venomous snakebites result in negligible or trivial envenomation.

Bites and stings from spiders and scorpions can be painful and can result in illness and death, particularly among infants and children. Other insects and arthropods (e.g., mosquitoes, ticks) can transmit infections (see Sec 4, Ch. 6, Mosquitoes, Ticks & Other Arthropods).

Most injuries from marine fish and invertebrates occur from chance encounters or defensive maneuvers. Resulting wounds have many common characteristics: bacterial contamination, foreign bodies, and occasionally venom. The incidence of venomous injuries from marine fish and invertebrates is rising as the popularity of surfing, scuba diving, and snorkeling increases. Most species responsible for human injuries, including jellyfish, scorpionfish, stingrays, stonefish, and sea urchins, live in tropical coastal waters.

Prevention

SITUATIONAL AWARENESS

Most stings and envenomation result from startling, stepping on, handling, attempting to feed, or otherwise harassing an animal. Before engaging in recreational activities, travelers should try to learn about the animals they might encounter, including their characteristics and habitats. Travelers should be especially aware of their surroundings at night and during warm weather, when snakes tend to be more active. The same caveat (awareness of surroundings) applies when conditions involve poor visibility, rough water, or confined areas.

PROTECTIVE CLOTHING

Travelers planning hikes in outdoor areas possibly inhabited by venomous snakes or biting insects should wear heavy, ankle-high or taller boots, and long sleeves and pants (see Sec. 4, Ch. 6, Mosquitoes, Ticks & Other Arthropods, for information on proper insect repellent use). Advise travelers going surfing, diving, or snorkeling to wear rash guards and swim boots, or other protective footwear.

Management

Instruct travelers to seek immediate medical attention any time a sting or envenomation occurs. Lifeguard stations at beaches or local clinics might have treatment kits for common stings or envenomations. In case of injury, species identification can help direct the best course of treatment. If possible, travelers or their companions should provide photographs of the animal to aid medical personnel. Travelers or their companions can immobilize an affected limb and apply a pressure bandage that does not restrict blood flow as first aid measures during transport to a medical facility.

Victims or their companions should not make incisions at bite sites or use tourniquets to restrict blood flow to affected extremities. Snakebite care is controversial and is best left to local emergency medical personnel. Specific antivenoms are available for some snakes in some areas; knowing the species of snake involved might prove critical to management. Consultation with a herpetologist can be beneficial.

If the traveler does not see or recognize the animal, health care providers will need to base treatment on the nature of the injury and the clinical effects. Bear in mind that—in some cases, at least—signs and symptoms might not appear for hours after contact. Symptoms can range from localized mild swelling and redness to more severe clinical findings (e.g., difficulty breathing or swallowing, chest pain, intense pain at the sting or bite site). Medical management will vary according to the severity of symptoms; therapy could include diphenhydramine, steroids, pain medication, and antibiotics.

INHALATION & INGESTION

The normal flora in the saliva, urine, and feces of many animals are pathogenic for humans. Exposure to animal body fluids is not always obvious or recognized, however. For example, water contaminated with animal urine or feces might be used to wash food items. In 2008, an indirect (inhalation) exposure to Marburg virus occurred in 2 tourists who visited a cave inhabited by bats, Python Cave in western Uganda. One case was fatal, and neither person reported a bite or scratch from a bat. Caves and mines also have other inhalation and ingestion hazards, such as fungi (see Sec. 5, Part 4, Ch. 2, Histoplasmosis).

Prevention

To help prevent inhalation of aerosolized urine or feces, discourage travelers from going into densely populated animal habitats (e.g., caves, corrals, mines, tunnels) housing large populations of animals. Travelers planning to enter densely populated animal habitats (e.g., bat caves) should don protective equipment (e.g., face shield, respirator, gloves) and clothing. Upon leaving the area, travelers should appropriately doff dirty equipment and clothing and wash or bathe as soon as possible. Travelers also should plan to remove all food and drink from their backpacks before entering populated animal habitats.

Management

Illness related to animal excreta might not appear for hours or even weeks after exposure. Health care providers must take highly detailed travel histories that include all activities that could result in exposure to or contact with animals and their habitats.

BIBLIOGRAPHY

Daly RF, House J, Stanek D, Stobierski MG. Compendium of measures to prevent disease associated with animals in public settings. J Am Vet Med Assoc. 2017;251(11):1268–92.

Diaz JH. The global epidemiology, syndromic classification, management, and prevention of spider bites. Am J Trop Med Hyg. 2004;71(2):239–50.

Gauthier P, Bellanger A-P, Bozon F, Lepiller Q, Chirouze C, Marguet P. A survey investigating the current practice of French health professionals regarding infection risk after monkey bites. Zoonoses Public Health. 2020;67(2):193–7.

Gautret P, Harvey K, Pandey P, Lim PL, Leder K, Piyaphanee W, et al. Animal-associated exposure to rabies virus among travelers, 1997–2012. Emerg Infect Dis. 2015;21(4):569–77.

Han BA, Kramer AM, Drake JM. Global patterns of zoonotic disease in mammals. Trends Parasitol. 2016;32(7):565–77.

Hifumi T, Sakai A, Kondo Y, Yamamoto A, Morine N, Ato M, et al. Venomous snake bites: clinical diagnosis and treatment. J Intensive Care. 2015;3(16):1–9.

Meerburg BG, Singleton GR, Kijlstra A. Rodent-borne diseases and their risks for public health. Crit Rev Microbiol. 2009;35(3):221–70.

Wieten RW, Tawil S, van Vugt M, Goorhuis A, Grobusch MP. Risk of rabies exposure among travelers. Neth J Med. 2015;73(5):219–26.

World Health Organization. WHO expert consultation on rabies, second report. World Health Organ Tech Rep Ser. 2013;982:1–139.

Wu AC, Rekant SI, Baca ER, Jenkins RM, Perelygina LM, Hilliard JK, et al. Notes from the field: monkey bite in a public park and possible exposure to herpes B virus – Thailand, 2018. MMWR, 2020;69(9):247–8.

ZOONOSES—THE ONE HEALTH APPROACH

Ria Ghai, Casey Barton Behravesh

The One Health approach recognizes that the health of people is closely connected to the health of animals and our shared environment. This concept is not new but has been increasingly recognized in recent years as an effective way to address health issues at the human–animal–environment interface. One Health issues include zoonotic diseases, emerging infectious diseases like coronavirus disease 2019 (COVID-19), antimicrobial resistance, food safety and food security, and other shared health threats at the human–animal–environment interface.

Because no single person, organization, or sector can address challenges at the human–animal–environment interface, successful public health interventions require the cooperation of many partners. Professionals in human health (epidemiologists, nurses, physicians, public health practitioners), animal health (agricultural workers, paraprofessionals, veterinarians), environment

(climate scientists, ecologists, wildlife experts), and other areas of expertise need to communicate, collaborate on, and coordinate activities based on a common, overarching goal: to achieve optimal health outcomes for people, animals, plants, and our shared environment.

Numerous benefits of One Health collaboration have been documented. For example, rabies is fatal in >99% of human cases and causes ≈59,000 human deaths annually around the world. Most (>99%) deaths are associated with exposure to rabid dogs. Preventing rabies in canines through annual or biannual mass dog vaccination campaigns has effectively prevented human-associated mortality. To be most successful, this strategy requires a One Health approach that includes partnership between human, animal, and environmental health professions at the programmatic and policy levels.

ZOONOTIC DISEASES

Zoonotic diseases are diseases that can be transmitted between animals. Zoonotic diseases require a One Health approach for effective prevention, detection, and response. Approximately 60% of all known human infectious disease agents originate in animals, including *Brucella*, HIV, *Salmonella*, and rabies virus. Most new or emerging infectious diseases in humans are zoonotic (e.g., COVID-19, Ebola, and highly pathogenic avian influenza). Furthermore, 80% of diseases with bioterrorism potential are zoonotic (e.g., anthrax, plague).

ONE HEALTH & TRAVEL MEDICINE

International travelers can be at risk for zoonotic diseases through various types of exposures, not just direct or indirect contact with wild or domestic animals or arthropod vectors. Contaminated environmental surfaces, freshwater sources (e.g., ponds, rivers), and food and beverages have been implicated as sources of zoonotic illness in humans. Failure to identify sources of exposure associated with a traveler's destination, itinerary, and activities can delay correct diagnosis and treatment and potentially increase the risk for further transmission of disease.

Patients benefit when health care providers use a One Health approach. In pretravel consultations, ensure travelers are aware of zoonotic and other infectious disease risks in areas where they are traveling, and encourage them to take measures to prevent or reduce those risks. For example, advise travelers to avoid settings with elevated zoonotic disease transmission risks like wildlife markets and farms. Consider administering rabies vaccine or offer prophylactic medications (e.g., antibiotics), as appropriate, to travelers for whom visiting high-risk zoonotic transmission settings is unavoidable.

In the posttravel setting, ask questions about interactions with animals, including domestic animals like companion and production animals and wildlife, both free-ranging and captive. Inquire about the apparent health of these animals and about animal habitats encountered during travel. Occasionally, health care providers and other zoonotic disease experts (e.g., veterinarians) might need to consult on a patient with a suspected zoonotic disease.

DIRECT & INDIRECT ANIMAL CONTACT

Travelers should be aware of the risks associated with animal contact. Direct contact with the saliva, blood, urine, mucus, feces, or other body fluids of an infected animal increases the risk for exposure to zoonotic pathogens; common routes of contact include petting or handling animals and being bitten or scratched (see Sec. 4, Ch. 7, Zoonotic Exposures: Bites, Stings, Scratches & Other Hazards). Additionally, visits to locations that pose a heightened risk of contact with animals that can carry diseases, such as wet markets where animals and their products are sold, or caves inhabited by bats, are best avoided when possible.

Because knowing which animals could be carrying pathogenic organisms can be difficult, especially because animal carriers often appear healthy, recommend that travelers avoid contact with unfamiliar animals and their products, including gifts or souvenirs made of animal products that might not have been treated to ensure their safety. If contact with live animals or animal products cannot be avoided, travelers should ensure they seek medical care immediately if they are bitten, scratched, or develop signs of illness

following animal interactions, and report their animal interactions to the health care provider.

ZOONOTIC DISEASE VECTORS

Plague (*Yersinia pestis* infection), rickettsial diseases, and yellow fever are examples of zoonotic diseases transmitted by insect vectors. Travelers can minimize exposure to vectors by adhering to insect precautions and regularly performing tick checks on people and any traveling pets (see Sec. 4, Ch. 6, Mosquitoes, Ticks & Other Arthropods).

ZOONOTIC FOODBORNE EXPOSURES

Because many foodborne pathogens have an animal reservoir, consuming raw or undercooked animal parts or products exposes travelers to zoonotic pathogens. In many developing countries, for example, unpasteurized milk, or dairy products made from unpasteurized milk, such as cheese, could put travelers at risk for *Brucella*, *Campylobacter*, *Cryptosporidium*, *Listeria*, and other pathogens. Travelers should avoid eating bushmeat—raw, smoked, or partially processed meat from bats, nonhuman primates, rodents, or other wild animals. Advise travelers to eat only fully cooked meat, eggs, fish, shellfish, and other foods, and to drink only pasteurized milk and dairy products, to reduce the risk for foodborne illness while traveling (see Sec. 2, Ch. 8, Food & Water Precautions, for more details).

BIBLIOGRAPHY

Angelo KM, Barbre K, Shieh WJ, Kozarsky PE, Blau DM, Sotir MJ, Zaki SR. International travelers with infectious diseases determined by pathology results, Centers for Disease Control and Prevention—United States, 1995–2015. Trav Med Infect Dis. 2017;19:8–15.

Centers for Disease Control and Prevention. Healthy pets, healthy people. Available from: www.cdc.gov/healthypets.

Centers for Disease Control and Prevention. One Health. Available from: www.cdc.gov/onehealth/index.html.

Daly RF, House J, Stanek D, Stobierski MG. Compendium of measures to prevent disease associated with animals in public settings, 2017. J Am Vet Med Assoc. 2017;251(11):1269–92.

Day M. Human-animal health interactions: the role of One Health. Am Fam Phys. 2016;93(5):344–6.

Food and Agriculture Organization of the United Nations, World Organization for Animal Health, and World Health Organization. Taking a multisectoral, One Health approach: a tripartite guide to addressing zoonotic diseases in countries. Geneva: The Organizations; 2019.

Hurley JW, Friend M. Zoonoses and travel. In: Friend M, editor. Disease emergence and resurgence: the wildlife-human connection. Reston (VA): US Geological Survey; 2006. pp. 191–206.

BRINGING ANIMALS & ANIMAL PRODUCTS INTO THE UNITED STATES

G. Gale Galland, Emily Pieracci, Kendra Stauffer

The Centers for Disease Control and Prevention (CDC) restricts the importation of any animals or animal products into the United States that might pose a public health threat. Any animal or animal product can be restricted from entry if CDC has reasonable knowledge or suspicion that it poses a human health risk. CDC currently has explicit restrictions for specific animals, including bats, cats, civets, dogs, insects and other non-animal vectors, nonhuman primates, African rodents, and some turtles, as well as products made from these animals. Importers must comply with CDC requirements to bring these animals or items into the United States.

Any animal, including service and emotional support animals, that leaves the United States must meet all entry requirements to reenter the United States, even if the animal previously lived in the United States (see Sec. 7, Ch. 6, Traveling with Pets & Service Animals). Many animals also are regulated by other federal agencies or by state governments. Therefore, travelers should check with the US Department of Agriculture (USDA), the US Fish and Wildlife Service (FWS), and the destination state and territorial health authorities for specific rules about importation.

Animal import and reentry requirements vary depending on the countries visited while abroad. Travelers should check entry requirements provided by CDC (www.cdc.gov/importation/bringing-an-animal-into-the-united-states/index.html), USDA (www.aphis.usda.gov/aphis/pet-travel/bring-pet-into-the-united-states), and FWS (www.fws.gov/international/Permits/by-activity/personal-pets.html). Travelers also should check USDA requirements for interstate transport of animals in US states and territories (www.aphis.usda.gov/aphis/pet-travel/interstate-pet-travel).

ANIMAL HEALTH CERTIFICATES

CDC does not require general health certificates for animals entering the United States. Some states or territories might require health certificates for entry, however, and some airlines might require these certificates for transport. Before departure, travelers should check with the departments of health and agriculture at the destination, and with the airline, for any health certificate requirements. The department of environmental protection or department of natural resources of some states and local governments might have additional requirements.

INTERNATIONAL PET RESCUE & ADOPTION

Although often done with the best of intentions, rescuing and importing stray animals from foreign countries can create human health risks when those animals are introduced into the United States. Travelers are at an increased risk for bites and scratches from fearful and stressed animals, which could result in injury or exposure to infectious diseases (e.g., rabies). Animals infected with zoonotic diseases might not show outward signs of being ill, but can still spread these diseases to people. Therefore, all rescued animals should be examined by a licensed veterinarian before departure from the country of origin and after arrival into the United States. Travelers who intend on rescuing animals should visit a travel medicine clinic prior to departure to discuss rabies preexposure prophylaxis.

In July 2021, CDC implemented a temporary suspension for the importation of dogs from countries with a high risk of dog-maintained rabies virus variant (DMRVV; see Bringing a Dog into the United States, www.cdc.gov/dogtravel). During the suspension period, dogs rescued or adopted from high-risk countries must enter the United States through a CDC-approved port of entry (Atlanta, Los Angeles, Miami, or New York) and undergo examination and revaccination against rabies immediately upon arrival (www.cdc.gov/importation/bringing-an-animal-into-the-united-states/approved-care-facilities.html). Dogs that do not meet CDC's entry requirements will be denied entry and returned to the country of departure at the importer's expense.

IMPORTING LIVE ANIMALS

Bats

Bats are reservoirs of many viruses that can infect humans; examples include filoviruses, Nipah, rabies, and severe acute respiratory syndrome (SARS) coronaviruses. To reduce the risk of introducing these viruses, CDC requires a permit for importation of all live bats and does not allow bats to be imported as pets. Bat import permit applications must be submitted electronically at www.cdc.gov/cpr/ipp/applications/index.htm. Many bat species require additional FWS permits.

Cats

Cats are subject to inspection at US ports of entry and can be denied entry if there is evidence of infection with a disease of public health concern. If a cat appears ill, examination by a licensed veterinarian at the owner's expense might be required before entry is permitted. CDC does not require cats to have proof of rabies vaccination for importation into the United States, but does recommend vaccination. In addition, many states and

territories have rabies vaccination requirements for cats. Importers should check with state and territorial health authorities at the destination to determine whether state or territorial agencies require rabies vaccinations for cats (see www.cdc.gov/importation/bringing-an-animal-into-the-united-states/cats.html).

Civets & Related Animals

To reduce the risk of introducing severe acute respiratory syndrome (SARS) coronavirus, the United States does not allow importation of civets and related animals in the family Viverridae. With permission from CDC, however, exceptions can be made for animals imported for science, education, or exhibition (see www.cdc.gov/importation/bringing-an-animal-into-the-united-states/civets.html). People who want to import civets and related animals should check with the USDA and FWS for additional requirements.

Dogs

Dogs are subject to inspection upon entry into the United States if they have evidence of infection with a communicable disease or if they have not been vaccinated against rabies. If a dog appears ill, examination by a licensed veterinarian, at the owner's expense, might be required before entry is permitted.

Rabies vaccination is required for all dogs, including service animals and emotional support animals, entering the United States from a country that is considered at high risk for DMRVV, as determined by CDC rabies experts. Dogs from high-risk countries must be accompanied by a current, valid rabies vaccination certificate that includes the following information:

- Name and address of owner
- Breed, sex, age, color, markings, and other identifying information for the dog
- Date of rabies vaccination and vaccine product information
- Date of expiration of vaccination
- Name, license number, address, and signature of administering veterinarian

Rabies certificates have expiration dates ranging from 1–3 years from the date of vaccination, depending on the type of vaccine. All dogs must be ≥12 weeks (84 days) old before receiving their first rabies vaccination. Rabies vaccinations must occur ≥28 days before arrival in the United States, because it takes 28 days for full vaccine effectiveness. Additional requirements apply during the period of CDC's temporary suspension on the importation of dogs from high-risk countries.

CDC recommends, and most US state and local authorities require, routine rabies vaccination of dogs. Importers should check with state and local authorities at the final destination to determine requirements for rabies vaccination.

STATES & TERRITORIES WITH ADDITIONAL REQUIREMENTS

All dogs and cats arriving in the state of Hawaii or the territory of Guam, even those arriving from the US mainland, are subject to locally imposed quarantine requirements. For more information about animal importation into Hawaii, see http://hdoa.hawaii.gov/ai/aqs. For more information about animal importation into Guam, see https://doag.guam.gov/animal-health-animal-control.

Insects

Importation of insect vectors and infectious biologic agents are regulated under the same program as bats. In some circumstances, known vectors of human disease (e.g., ticks, mosquitoes), can be imported into the United States with a permit from CDC (at www.cdc.gov/cpr/ipp/index.htm).

Primates

Nonhuman primates can transmit a variety of serious diseases to humans, including Ebola virus disease and tuberculosis. Nonhuman primates can be imported into the United States only by a CDC-registered importer and only for scientific, educational, or exhibitory purposes. All nonhuman primates are considered endangered or threatened, and they also require FWS permits for importation.

Nonhuman primates cannot be imported as pets. Nonhuman primates kept as pets in the United States that travel outside the country will not be allowed to reenter the United States as pets

(see www.cdc.gov/importation/bringing-an-animal-into-the-united-states/monkeys.html).

Rodents

African rodents are a known source of communicable diseases (e.g., monkeypox) that can be transferred to humans. CDC does not allow the importation of these animals. Exceptions might be made for animals imported for science, education, or exhibition, with permission from CDC. Importers should check with USDA and FWS for additional requirements to import African rodents (see www.cdc.gov/importation/bringing-an-animal-into-the-united-states/african-rodents.html).

Turtles

Turtles often are kept as pets but can transmit *Salmonella* to humans. CDC restricts the importation of some turtles. A person can import ≤6 viable turtle eggs or live turtles with a shell length <4 inches (10 cm) for noncommercial purposes. More live turtles or viable turtle eggs can be imported with CDC permission, but only for science, education, or exhibition. CDC does not restrict the importation of live turtles with a shell length ≥4 inches (see www.cdc.gov/importation/bringing-an-animal-into-the-united-states/turtles.html). Importers should check with USDA and FWS for additional requirements to import turtles.

Other Animals

Travelers planning to import horses, poultry or other birds, ruminants, swine, or dogs used for handling livestock or for commercial resale or adoption should contact the National Import Export Services, a part of the USDA Animal and Plant Health Inspection Service, at 301-851-3300, or visit www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-and-animal-product-import-information to learn about additional requirements.

Travelers planning to import bears, wild birds, wild members of the cat family, fish, rabbits, reptiles, spiders, or other wild or endangered animals should contact FWS at 800-344-9453 (toll-free general number) or 703-358-1949 (FWS Office of Law Enforcement), or visit www.fws.gov/program/office-of-law-enforcement/information-importers-exporters.

IMPORTING ANIMAL PRODUCTS

Bushmeat

Imported animal products often include items intended for human consumption. Bushmeat, generally raw, smoked, or partially processed meat from wild animals, might harbor infectious or zoonotic agents that can cause human or animal disease. As people have migrated around the world, bushmeat has become a growing commodity in the global wildlife trade.

CDC prohibits importation of bushmeat from CDC-restricted species into the United States. Bushmeat from other species also is restricted under USDA or FWS regulations. In addition to the human and animal health risks, many of the wild animals commonly hunted for bushmeat are threatened or endangered species protected by international wildlife laws and treaties (e.g., the Convention on International Trade of Endangered Species [CITES]).

For additional information about importing animals and animal products into the United States and for permit applications, travelers should visit www.cdc.gov/importation/index.html or contact 1-800-CDC INFO (1-800-232-4636). To request CDC permission to import a CDC-regulated animal or product, send an email to CDCanimalimports@cdc.gov.

Trophies & Other Animal Products

Travelers often want to import animal skins, hunting trophies, or other items made from animals when returning from a trip. These items must either be rendered noninfectious (see www.cdc.gov/importation/animal-products.html) or be accompanied by an import permit. CDC restricts products made from bats, nonhuman primates, African rodents, and civets and related animals in the family Viverridae. These products also might be regulated by other US federal agencies.

CDC has the right to restrict other items known to carry infectious diseases. For example, CDC restricts bringing souvenirs made from goat hide (e.g., goatskin drums) into the United States because they have been associated with cases of anthrax in humans. Travelers who want to import hunting trophies or other products made from animals should check with CDC, USDA, and FWS to make sure they comply with federal regulations.

BIBLIOGRAPHY

Allocati, N, Petrucci, AG, DiGiovanni, P, Masulli, M, DiIlio, C KeLaurenzi, VE. Bat–man disease transmission: zoonotic pathogens from wildlife reservoirs to human populations. Cell Death Discov. 2016;2:16048.

Centers for Disease Control and Prevention. Multistate outbreak of monkeypox—Illinois, Indiana, and Wisconsin, 2003. MMWR Morb Mortal Wkly Rep. 2003;52(23):537–40.

Centers for Disease Control and Prevention. Multistate outbreak of Salmonella infections associated with exposure to turtles—United States, 2007–2008. MMWR Morb Mortal Wkly Rep. 2008;57(3):69–72.

DeMarcus TA, Tipple MA, Ostrowski SR. US policy for disease control among imported nonhuman primates. J Infect Dis. 1999;179 Suppl 1:S281–2.

Jansen W, Merkle M, Daun A, Flor M, Grabowski NT, Klein G. The quantity and quality of illegally imported products of animal origin in personal consignments into the European Union seized at two German airports between 2010 and 2014. Plos One. 2016;11(2):1–14.

Pieracci EG, Pearson CM, Wallace RM, Blanton JD, Whitehouse ER, Ma X, et al. Vital signs: trends in human rabies deaths and exposures—United States, 1938–2018. MMWR Morb Mortal Wkly Rep. 2019;68(23):524–8.

Murphy J, Sirfri, CD, Pruitt R, Hornberger M, Bonds D, Blanton J, et al. Human rabies—Virginia, 2017. MMWR Morb Mortal Wkly Rep. 2019;67(5152):1410–4.

National Association of State Public Health Veterinarians, Compendium of Animal Rabies Prevention and Control Committee; Brown CM, Slavinski S, Ettestad P, Sidwa TJ, Sorhage FE. Compendium of animal rabies prevention and control, 2016. J Am Vet Med Assoc. 2016;248(5):505–17.

Wu D, Tu C, Xin C, Xuan H, Meng Q, Liu Y, et al. Civets are equally susceptible to experimental infection by two different severe acute respiratory syndrome coronavirus isolates. J Virol. 2005;79(4):2620–5.

FOOD POISONING FROM MARINE TOXINS

Vernon Ansdell

Poisoning from ingesting marine toxins is an underrecognized hazard for travelers, particularly in the tropics and subtropics. Climate change, coral reef damage, expanding international trade and tourism, growing seafood consumption, and spread of toxic algal blooms are all contributing to an increasing risk (Map 4-01).

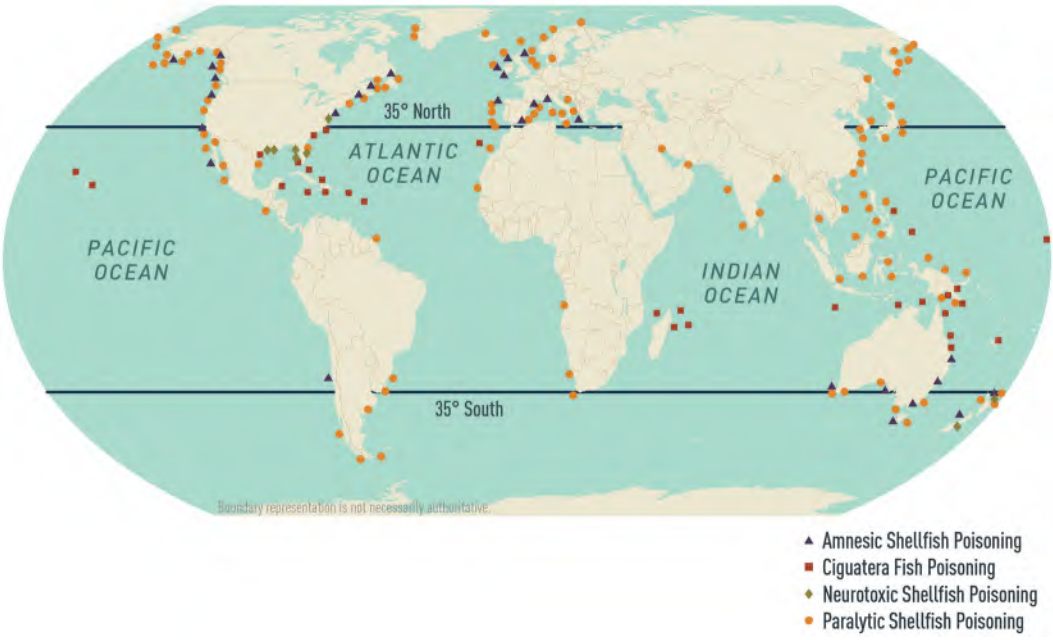
CIGUATERA FISH POISONING

Ciguatera fish poisoning occurs after eating reef fish contaminated with toxins like ciguatoxin or maitotoxin. These potent toxins originate from *Gambierdiscus toxicus*, a small marine organism (dinoflagellate) that grows on and around coral reefs. Dinoflagellates are ingested by herbivorous fish. The toxins produced by *G. toxicus* are then modified and concentrated as they pass up the marine food chain to carnivorous fish and finally to humans. Ciguatoxins are concentrated in fish liver, intestines, roe, and heads.

G. toxicus might proliferate on dead coral reefs more effectively than other dinoflagellates. The risk for ciguatera poisoning is likely to increase as coral reefs deteriorate because of climate change, ocean acidification, offshore construction, and nutrient runoff.

Risk to Travelers

Approximately 50,000 cases of ciguatera poisoning are reported worldwide annually, but because the disease is underrecognized and underreported, reports are likely grossly underestimated. The incidence in travelers to highly endemic areas has been estimated as high as 3 per 100. Ciguatera is widespread in tropical and subtropical waters, usually between the latitudes of 35°N and 35°S, and is particularly common in the Pacific and Indian Oceans and the Caribbean Sea. The incidence and geographic distribution of ciguatera poisoning are increasing. Newly recognized areas of risk include Madeira and the Canary Islands, parts of the Mediterranean, and the western Gulf of Mexico. Be aware that travelers with ciguatera fish poisoning might seek care after returning home to



MAP 4-01 Worldwide distribution of selected seafood poisonings

Source: US National Office for Harmful Algal Blooms, Woods Hole Oceanographic Institution, Woods Hole, MA: 2016. Available from: https://hab.whoi.edu/maps/regions-world-distribution/. Harmful algal blooms (HABs) occur widely and contribute to seafood toxicity. Risk for human poisoning depends on the particular seafood consumed, where it was caught or harvested, and—in some instances—the exposure of that seafood to an HAB.

nonendemic (temperate) areas. In addition, cases of ciguatera fish poisoning are seen with increasing frequency in nonendemic areas because of the increasing global trade in seafood products.

Fish most likely to cause ciguatera poisoning are large carnivorous reef fish (e.g., amberjack, barracuda, grouper, moray eel, sea bass, sturgeon). Omnivorous and herbivorous fish (e.g., parrot fish, red snapper, surgeonfish) also can be a risk.

Clinical Presentation

Ciguatera poisoning can cause cardiovascular, gastrointestinal, neurologic, and neuropsychiatric illness. The first symptoms usually develop within 3–6 hours after eating contaminated fish but can be delayed up to 30 hours. General signs and symptoms include fatigue, general malaise, and insomnia. Cardiovascular signs and symptoms include bradycardia, heart block, or hypotension. Gastrointestinal signs and symptoms include diarrhea, nausea, vomiting, and abdominal pain. Neurologic and neuropsychiatric signs and symptoms include paresthesia, weakness, pain in the teeth or a sensation that the teeth are loose, a burning or metallic taste in the mouth, generalized itching, sweating, and blurred vision. Cold allodynia (abnormal sensation when touching cold water or objects) has been a reported characteristic, but acute sensitivity to both heat and cold can be present. Neurologic symptoms usually last a few days to several weeks but can persist for months or even years.

The overall death rate from ciguatera poisoning is <0.1% but varies according to the toxin dose and availability of medical care to deal with complications. The diagnosis of ciguatera poisoning is based on the characteristic signs and symptoms and a history of eating fish species known to carry ciguatera toxin. The US Food and Drug Administration (FDA) can test fish in their laboratory at Dauphin Island, Alabama. No test for ciguatera toxins in human clinical specimens is readily available.

Prevention

Ciguatera toxins do not affect the texture, taste, or smell of fish, nor are they destroyed by canning, cooking, freezing, pickling, salting, or smoking, or by gastric acid. To prevent ciguatera fish

poisoning, travelers should avoid or limit consumption of reef fish, particularly fish that weigh >5 pounds; counsel travelers to never eat high-risk fish (e.g., barracuda, moray eel) and to avoid eating the parts of the fish (e.g., the head, intestines, liver, roe) that concentrate ciguatera toxin.

Treatment

No specific antidote for ciguatoxin or maitotoxin poisoning is available. Symptomatic treatments include amitriptyline for chronic paresthesias, depression, or pruritus; fluoxetine for chronic fatigue; gabapentin or pregabalin for neuropathic symptoms; and nifedipine or acetaminophen for headaches. Intravenous mannitol has been reported in uncontrolled studies to reduce the severity and duration of neurologic symptoms, particularly if given ≤48 hours of symptom onset; give mannitol only to hemodynamically stable, well-hydrated patients.

After recovery, advise patients to avoid consuming alcohol, caffeine, fish, and nuts for ≥6 months because these might cause symptom relapse.

SCOMBROID

Scombroid is caused by eating fish that contain high levels of histamine. Bacteria convert histidine, an essential amino acid found in the flesh of the fish, to histamine. The process of histidine conversion can be mitigated by inhibiting bacterial growth through proper storage of freshly caught fish by refrigeration or icing. Conversely, when fish are improperly stored after capture, bacterial overgrowth can occur, facilitating and accelerating histamine production.

One of the most common fish poisonings, scombroid occurs worldwide in both temperate and tropical waters. Fish typically associated with scombroid have naturally high levels of histidine in their flesh and include amberjack, anchovies, bluefish, herring, mackerel, mahi mahi (dolphin fish), marlin, sardines, and tuna. Histamine and other scombrotoxins are resistant to canning, cooking, freezing, and smoking.

Clinical Presentation

Scombroid poisoning resembles an acute allergic reaction and usually appears 10–60 minutes after a person eats contaminated fish. Signs and symptoms include abdominal cramps and diarrhea, blurred vision, flushing of the face and upper body resembling sunburn, severe headaches, itching, and palpitations. Left untreated, symptoms usually resolve within 12 hours but can last ≤48 hours.

Rarely, respiratory compromise, malignant arrhythmias, and hypotension requiring hospitalization can occur. Scombroid poisoning has no long-term sequelae and usually is diagnosed from clinical signs and symptoms. Clustering of cases helps exclude the possibility of true fish allergy.

Prevention

Fish contaminated with histamine can have a peppery, sharp, or salty taste or a "bubbly" feel, but will usually look, smell, and taste normal. The key to prevention is to make sure fish are properly iced or refrigerated at temperatures <38°F (<3.3°C) or immediately frozen after being caught. Canning, cooking, freezing, or smoking will not destroy histamine in contaminated fish.

Treatment

Scombroid poisoning usually responds well to antihistamines, typically H1-receptor antagonists, although H2-receptor antagonists also might provide some benefit.

SHELLFISH POISONING

Shellfish, including crustaceans (Dungeness crab, lobster, and shrimp), filter-feeding bivalve mollusks (clams, cockles, mussels, oysters, and scallops), and gastropod mollusks (abalone, moon snails, and whelks) can harbor toxins that result in several different poisoning syndromes. Toxins originate in small marine organisms (diatoms or dinoflagellates) ingested and concentrated by shellfish.

Risk to Travelers

Contaminated (toxic) shellfish can be found in temperate and tropical waters, typically during or after phytoplankton blooms, also called harmful algal blooms (HABs). One example of a HAB is the Florida red tide caused by *Karenia brevis*.

Clinical Presentation

Poisoning results in gastrointestinal and neurologic illness of varying severity. Symptoms

typically appear 30–60 minutes after a person ingests toxic shellfish but can be delayed for several hours. Diagnosis is usually through exclusion, and typically is made clinically in patients with a history of having recently eaten shellfish.

AMNESIC SHELLFISH POISONING

Amnesic shellfish poisoning (ASP) is a rare form of shellfish poisoning caused by eating shellfish contaminated with domoic acid, produced by diatoms of the *Pseudonitzchia* spp. Outbreaks of ASP have been reported in the Americas (Canada, Chile), Europe (Belgium, France, Ireland, Portugal, Scotland, Spain), and the Pacific (Australia, New Zealand). Implicated shellfish include razor clams, mussels, scallops, and other crustaceans.

In most cases, gastrointestinal symptoms (e.g., abdominal pain, diarrhea, vomiting) develop within 24 hours of eating toxic shellfish, followed by headache, cognitive impairment, and memory loss. Symptoms usually resolve within hours to days after shellfish ingestion. Hypotension, arrhythmias, ophthalmoplegia, coma, and death have been reported in severe cases. Survivors might exhibit severe anterograde, short-term memory deficits.

DIARRHEIC SHELLFISH POISONING

Diarrheic shellfish poisoning (DSP) results from eating shellfish contaminated with toxins (e.g., okadaic acid). DSP occurs worldwide, and outbreaks have been reported in the Americas (Canada, Chile, United States, and Uruguay), Asia (China, Japan), and Europe (Belgium, France, Ireland, Scandinavia, Spain).

Most cases result from eating toxin-containing bivalve mollusks (e.g., mussels, scallops). Symptoms usually occur within 2 hours of consumption and include abdominal pain, chills, diarrhea, nausea, and vomiting. Symptoms usually resolve within 2–3 days. No deaths from DSP have been reported.

NEUROTOXIC SHELLFISH POISONING

Neurotoxic shellfish poisoning (NSP) is caused by eating shellfish contaminated with brevetoxins produced by the dinoflagellate *K. brevis*. NSP is predominately an illness of the Western Hemisphere (the Caribbean, Gulf of Mexico, southeastern coast of the United States), but the disease also has been reported from New Zealand.

NSP usually presents as a gastroenteritis accompanied by neurologic symptoms resembling mild ciguatera or paralytic shellfish poisoning (described below), 30 minutes to 3 hours after a person eats shellfish. Aerosolized red tide respiratory irritation (ARTRI) also can occur when people inhale aerosolized brevetoxins in sea spray, and has been reported in association with a red tide (*K. brevis* HAB) in Florida. ARTRI can induce bronchoconstriction and cause acute, temporary respiratory discomfort in healthy people. People with asthma might experience more severe and prolonged respiratory effects.

PARALYTIC SHELLFISH POISONING

Paralytic shellfish poisoning (PSP) is the most common and most severe form of shellfish poisoning. PSP is caused by eating shellfish contaminated with saxitoxins. These potent neurotoxins are produced by various dinoflagellates. A wide range of shellfish can cause PSP, but most cases occur after people eat clams or mussels.

PSP occurs worldwide but is most common in temperate waters off the Atlantic and Pacific coasts of North America, including Alaska. Other countries in the Americas (Chile), as well as countries in Asia (China, the Philippines), Europe (Ireland, Scotland), and the Pacific (Australia, New Zealand) have also reported cases.

Symptoms usually appear 30–60 minutes after a person eats toxic shellfish and include numbness and tingling of the face, lips, tongue, arms, and legs. Patients also might have diarrhea and vomiting, headache, and nausea. Severe cases are associated with ingestion of large doses of toxin and clinical features such as ataxia, dysphagia, flaccid paralysis, mental status changes, and respiratory failure. The case-fatality ratio depends on the availability of modern medical care, including mechanical ventilation; rates of death among children can be particularly high.

Prevention

Shellfish poisoning can be prevented by avoiding potentially contaminated shellfish, which is particularly important in areas during or shortly after algal blooms, locally referred to as

"red tides" or "brown tides." Consuming shellfish also carries a very high risk for infection from various viral (e.g., hepatitis A virus, norovirus) and bacterial (e.g., *Salmonella*, *Shigella*, *Vibrio parahaemolyticus*, and *V. vulnificus*) pathogens. Ideally, travelers to developing countries should consider avoiding eating shellfish. Marine shellfish toxins cannot be destroyed by cooking or freezing.

Treatment

Treatment is symptomatic and supportive. Severe cases of paralytic shellfish poisoning might require mechanical ventilation.

BIBLIOGRAPHY

Chan TY. Ciguatera fish poisoning in East Asia and Southeast Asia. Mar Drugs. 2015;13(6):3466–78.

Friedman MA, Fleming LE, Fernandez M et al. Ciguatera fish poisoning: treatment, prevention and management. Mar Drugs. 2008;6:456–79.

Hungerford JM. Scombroid poisoning: a review. Toxicon. 2010;56(2):231–43.

Isbister GK, Kiernan MC. Neurotoxic marine poisoning. Lancet Neurol. 2005;4(4):219–28.

Palafox NA, Buenoconsejo-Lum LE. Ciguatera fish poisoning: review of clinical manifestations. J Toxicol Toxin Rev. 2001;20(2):141–60.

Schnorf H, Taurarii M, Cundy T. Ciguatera fish poisoning: a double-blind randomized trial of mannitol therapy. Neurology. 2002;58(6):873–80.

Sobel J, Painter J. Illnesses caused by marine toxins. Clin Infect Dis. 2005;41(9):1290–6.

SAFETY & SECURITY OVERSEAS

Virginia Lehner

US citizens traveling abroad face a wide range of risks not generally prevalent in the United States. These risks include sanitation issues (e.g., non-potable water), increased risk for traffic accidents due to poor road conditions and unfamiliarity with local norms, local insectborne illness or disease vectors, injury from adventure tourism or overexposure to unfamiliar climates, and violence ranging from petty theft to terrorism.

Travelers going overseas, particularly tourists, can also face additional challenges in seeking help when they find themselves in distress. Language, culture, and local laws can be barriers, and travelers might not have an immediately accessible network of friends or family to assist them in an emergency. Local government responses to accidents or crime might not be what travelers expect; in some instances, an effective local government might not even exist to respond. Travelers should research conditions at their destination before departure to learn what risks they could likely face and make plans to mitigate those risks abroad.

INFORMED TRAVEL

As indicated above, travelers should make informed decisions prior to departure, based on clear, timely, and reliable safety and security information. The Bureau of Consular Affairs (CA) within the US Department of State (the organization charged with protecting US citizens abroad) provides would-be travelers with a broad range of information for every country in the world through its webpages, Travel.State.Gov (https://travel.state.gov/content/travel.html) and US Embassy and Consulate (www.usembassy.gov/websites).

Travel Advisories & Travel to High-Risk Areas

At the broadest level, CA assigns every country a metrics-based travel advisory level ranging from 1: Exercise normal precautions to 4: Do

not travel. Travelers can see travel advisories at Travel.State.Gov (https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories.html); accompanying country information pages describe the risks and conditions and the actions travelers should take to mitigate risks in each country. Country information pages provide extensive travel information, including details about entry and exit requirements, local laws and customs, health conditions, accessibility for travelers with disabilities and for other key groups, typical scams and other crimes, transportation safety, and other relevant topics. The Department of State also warns people not to visit certain high-risk countries or areas because of local conditions and limited ability to provide consular services in those places (see https://travel.state.gov/content/travel/en/international-travel/before-you-go/travelers-with-special-considerations/high-risk-travelers.html).

US embassies and consulates abroad also issue event-based alerts to inform US citizens of specific safety, security, or health concerns that put travelers at immediate risk (e.g., civil aviation risks, crime threats, demonstrations, health events, weather events). For more information, see http://travel.state.gov/travelsafely.

Smart Traveler Enrollment Program (STEP)

Advise US citizen travelers to enroll with the Department of State's Smart Traveler Enrollment Program (STEP; https://step.state.gov/step). A free service, STEP allows enrollees to receive information and alerts from local US embassies or consulates about safety, security, or health conditions at their destination. STEP can also help the local embassy or consulate locate missing US citizens or contact them in an emergency (e.g., civil unrest, a family emergency, natural disasters).

Preparing Friends & Family

The Department of State advises travelers to share their itinerary with friends and family, including the names and contact information for travel agencies, planned tours, and lodging. Travelers should establish reasonable expectations for "check-in" communications with family and friends. In addition to having their own copies, travelers also should provide trusted friends and family with copies of important documents like passports, visas, health insurance cards, and credit cards in case any of these items are lost or stolen.

Medical Insurance

The US government does not provide medical insurance for US travelers overseas and will not pay costs for travelers receiving international medical care. Medicare and Medicaid do not cover these costs, nor do many private domestic health insurance plans. Thus, travelers should purchase supplemental insurance prior to travel (see Sec. 6, Ch. 1, Travel Insurance, Travel Health Insurance & Medical Evacuation Insurance). Because travel insurance policy coverages vary, travelers should carefully read the terms to make sure the policy fits their needs. Travelers might need additional insurance coverage to cover the costs of emergency medical care, medical transport back to the United States, travel and accommodation costs in the event of interrupted or delayed travel, 24-hour contact services, and treatment received overseas for any preexisting conditions, including pregnancy.

LOCAL LAWS

US citizens are subject to local laws during travel abroad. Travelers who violate those laws—even unknowingly—can face arrest, imprisonment, or deportation. In addition, some crimes are prosecutable both in the United States and in the country where the crime was committed. US citizens arrested or detained abroad should ask local law enforcement or prison officials to notify the US embassy or consulate immediately.

Faith-Based Travelers

Faith-based travel encompasses a wide range of activities (e.g., attending pilgrimages, participating in service projects, conducting missionary work, taking part in faith-based tours). Millions of faith-based travelers participate safely in some type of religious travel every year. In addition to being aware of basic country conditions that impact all travelers, US faith-based travelers should know that in some countries, conducting

religious activities without proper registration, or at all, is a crime (see https://travel.state.gov/content/travel/en/international-travel/before-you-go/travelers-with-special-considerations/faith-based-travel.html).

LGBTQ+ Travelers

Lesbian, gay, bisexual, transgender, queer, and intersex (LGBTQ+) travelers face unique challenges when traveling abroad (see Sec. 2, Ch. 13, LGBTQ+ Travelers, and https://travel.state.gov/content/travel/en/international-travel/before-you-go/travelers-with-special-considerations/lgbti.html). Laws and attitudes in some countries might negatively affect safety and ease of travel for LGBTQ+ persons, and legal protections vary between countries. Many countries do not legally recognize same-sex marriage and >70 countries criminalize consensual same-sex sexual relations, sometimes with severe punishment. Travelers should review the Human Rights Report (www.state.gov/reports-bureau-of-democracy-human-rights-and-labor/country-reports-on-human-rights-practices) for further details before travel.

Travelers with Disabilities

Each country has its own laws regarding accessibility for, or discrimination against, people with physical, sensory, intellectual, or mental disabilities. Enforcement of accessibility and other laws relating to people with disabilities is inconsistent (see Sec. 3, Ch. 2, Travelers with Disabilities, and https://travel.state.gov/content/travel/en/international-travel/before-you-go/travelers-with-special-considerations/traveling-with-disabilties.html).

Travelers with Dual Nationality

Countries have different regulations for dual nationals; some do not permit dual nationality, while others infer dual nationality based on the birthplace of a traveler's parent. US citizens should check with the embassy of any country for relevant nationality laws before travel (see https://travel.state.gov/content/travel/en/international-travel/before-you-go/travelers-with-special-considerations/Dual-Nationality-Travelers.html).

CRIME, CRISES & TERRORISM

Crime

Crime is one of the most common threats to the safety of US citizens abroad. Travelers should research crime trends and patterns at their destination using the Overseas Security Advisory Council Country Security Reports (www.osac.gov), which provide baseline security information for every country around the world. Although strategies to avoid becoming a crime victim are, for the most part, the same everywhere, travel health providers should stress the following points with international travelers:

- Avoid accommodations on the ground floor or immediately next to the stairs, and lock all windows and doors.
- Do not wear expensive clothing or accessories.
- If confronted in a robbery, give up all valuables and do not resist attackers. Resistance can escalate to violence and result in injury or death.
- Limit travel at night; travel with a companion, and vary routine travel habits.
- Take only recommended, safe modes of local transportation.

Crime victims should contact the local authorities and the nearest US embassy, consulate, or consular agency for assistance. The Department of State can help replace stolen passports, contact family and friends, identify health care providers, explain the local criminal justice process, and connect victims of crime with available resources, including a list of local attorneys and medical providers. The Department of State does not have the legal authority to conduct a criminal investigation, prosecute crimes, or provide legal advice or counsel.

Crises

Whether traveling or living outside the United States, US citizens should prepare for potential crises (see https://travel.state.gov/content/travel/en/international-travel/before-you-go/crisis-abroad--be-ready.html). The Department of State

is committed to assisting US citizens who become victims of crime, who need assistance during a crisis or a natural disaster, or who need consular services (e.g., replacing a lost or stolen passport, providing a loan to return to the United States). The Department of State also can attempt to locate missing US citizens abroad. Nevertheless, US citizens should proactively research resources available for the country or countries where they are traveling or residing, stay connected with the nearest US embassy or consulate, and create personal safety plans.

Terrorism

Despite being a worldwide threat and cause for concern, terrorist attacks have involved relatively few international travelers. Past attacks have included assassinations, bombings, hijackings, kidnappings, and suicide operations. Bombings are typically conducted with the use of improvised explosive devices (IEDs), but biological and chemical attacks remain a concern in some high-threat countries. Potential targets include business offices, clubs, hotels, houses of worship, public transportation systems, residential areas, restaurants, schools, shopping malls, high-profile sporting events, and other tourist destinations where people gather in large numbers (see https://travel.state.gov/content/travel/en/international-travel/emergencies/terrorism.html). To reduce their chances of becoming victims of terrorism, travelers should be cautious of unexpected packages; avoid wearing clothing that identifies them as a tourist (e.g., a T-shirt bearing the US flag or the logo of a favorite US-based sports team); look out for unattended bags or packages in public places and other crowded areas; and try to blend in with the locals. These strategies incorporate the same defensive alertness and good judgment that people should use to prevent becoming victims of crime. Awareness is key, and travelers should be knowledgeable of their surroundings and adopt protective measures.

BIBLIOGRAPHY

Federal Aviation Administration. Prohibitions, restrictions and notices. Available from: www.faa.gov/air_traffic/publications/us_restrictions.

US Department of State. Country information. Available from: https://travel.state.gov/content/travel/en/international-travel/International-Travel-Country-Information-Pages.html.

US Department of State. Country reports on human rights practices. Available from: www.state.gov/j/drl/rls/hrrpt.

US Department of State. Crisis abroad: be ready. Available from: https://travel.state.gov/content/travel/en/international-travel/before-you-go/crisis-abroad--be-ready.html.

US Department of State. Travel.State.Gov. Available from: https://travel.state.gov/content/travel.html.

INJURY & TRAUMA

Michael Ballesteros, Erin Sauber-Schatz

In 2017 and 2018, >1,500 US citizens died from nonnatural causes in foreign countries, excluding deaths in the wars in Iraq and Afghanistan. Motor vehicle crashes—not crime or terrorism—are the number 1 cause of nonnatural deaths among US citizens living, working, or traveling abroad (Figure 4-02). In 2017 and 2018, 431 Americans died in vehicle crashes in foreign countries (28% of nonnatural deaths). Another 291 were victims of homicide (19%), 266 drowned or died as a result of a boating incident (17%), and 218 died of suicide (14%).

Travel destinations might lack emergency care that approximates US standards; trauma centers capable of providing care for serious injuries are uncommon outside urban areas, if they exist at all. Make travelers aware of their increased risk for injuries when traveling or

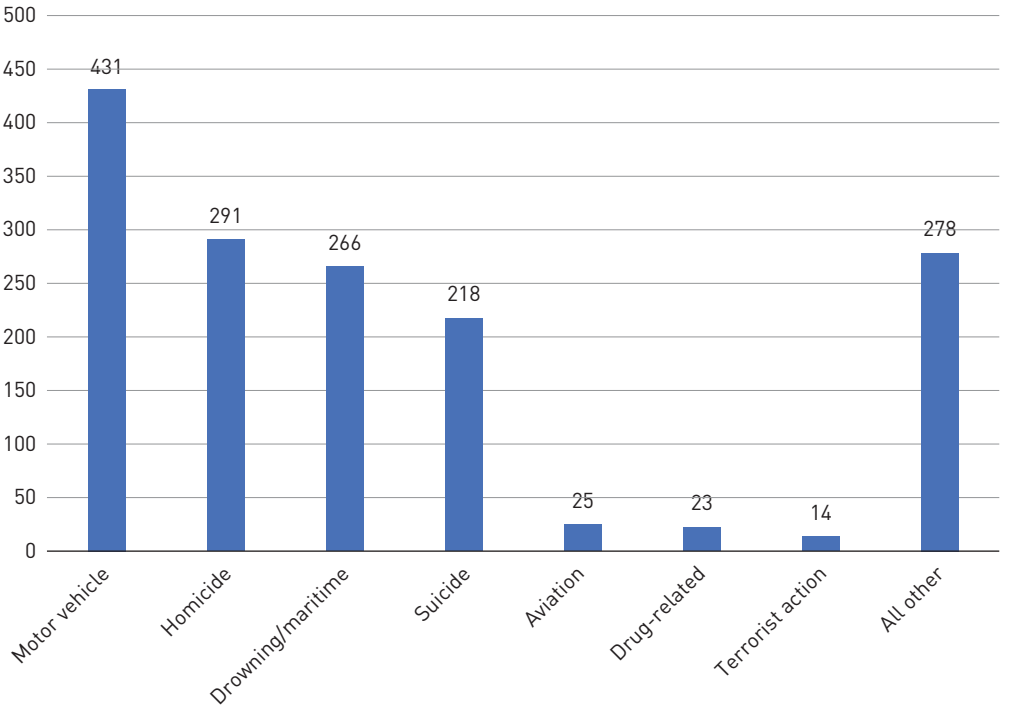


FIGURE 4-02 Leading causes of injury death for U.S. citizens in foreign countries, 2016 & 2017[1,2,3,4]

[1]Data from U.S. Department of State. Deaths of US citizens in foreign countries by nonnatural causes. Washington, DC: US Department of State. Available from: https://travel.state.gov/content/travel/en/international-travel/while-abroad/death-abroad1/death-statistics.html.
[2]Excludes deaths of US citizens fighting wars in Afghanistan or Iraq, and deaths not reported to the US embassy or consulate.
[3]Motor Vehicle includes deaths classified as "vehicle accidents," including the following subcategories: auto, bus, motorcycle, pedestrian, train, and other.
[4]All Other includes deaths classified as armed conflict, natural disaster, other accident, and undetermined/unknown.

residing internationally, particularly in low- and middle-income countries, and to take preventive steps to reduce the chances of serious injury.

ROAD TRAFFIC INJURIES

Globally, approximately 3,700 people are killed each day in motor vehicle crashes involving bicycles, buses, cars, motorcycles, trucks, and pedestrians. In 2017 and 2018, among the 431 US citizen road traffic deaths abroad, 62% were among drivers and occupants of passenger vehicles (e.g., cars, trucks, sport utility vehicles), and 21% were people on motorcycles. The countries with the most US citizen road traffic deaths were Mexico (n=126; 29%), Thailand (n=29; 7%), and Vietnam (n=17; 4%). For information on motor vehicle crashes and road safety, see Sec. 8, Ch. 5, Road & Traffic Safety.

VIOLENCE

Violence, including suicide and homicide, is a leading worldwide public health problem that affects US citizens traveling, working, or residing internationally. Each year, >1.6 million people lose their lives to violence, and only one-fifth of that total is due to armed conflict. Rates of violent deaths in low- and middle-income countries are 3 times those in higher-income countries, although variations exist within countries. For longer-term travelers, social isolation and substance abuse might increase the risk for depression and suicide; these risks might be amplified in areas with poverty and rigid gender roles. See Sec. 2, Ch. 12, Mental Health, for more detailed information on suicide prevention.

Mexico, the Philippines, Haiti, and Jamaica have the highest number of homicide deaths

among US citizens abroad; Mexico accounts for 52% of all homicide deaths in US citizens living or traveling in foreign countries. Criminals might view US travelers as wealthy, naïve targets, inexperienced and unfamiliar with the culture, and less able to seek assistance once victimized. Traveling in high-poverty areas or regions of civil unrest, using alcohol or drugs, and visiting unfamiliar environments, particularly at night, increase the likelihood of a traveler becoming a victim of violence (see Sec. 4, Ch. 11, Safety & Security Overseas, for more information).

WATER & AQUATIC INJURIES

Drowning is often the leading cause of injury death to US citizens visiting countries where water recreation is a major activity. Although risk factors are not clearly defined, lack of familiarity with local water currents and conditions, inability to swim, and absence of lifeguards on duty likely contribute to drowning deaths. Rip currents can be especially dangerous. Diving into shallow water is a risk factor for head and spinal cord injuries, and young men are affected disproportionately. In some cases of aquatic injuries, alcohol or drug use is a factor.

Boating can be a hazard, especially if boaters are unfamiliar with the equipment they are using, do not know proper boating etiquette or rules for watercraft navigation, or are new to the water environment in a foreign country. Many boating fatalities result from inexperience or failure to wear a personal flotation device (lifejacket); boaters should have enough lifejackets on board for all passengers. Children and weak swimmers should always wear a lifejacket whenever boating. Advise travelers not to ride in boats operated by obviously inexperienced, uncertified, or intoxicated drivers.

Scuba diving is a frequent pursuit of travelers to coastal destinations. Researchers estimate the death rate among divers worldwide is ≈16 deaths per 100,000 divers per year. Travelers should either be experienced divers or dive with a reputable dive shop and instructors. See the Sec. 4, Ch. 4, Scuba Diving: Decompression Illness & Other Dive-Related Injuries, for a more detailed discussion about diving risks and preventive measures.

Travelers should not swim alone or in unfamiliar waters and should wear appropriately sized, US Coast Guard–approved lifejackets whenever participating in water recreation activities (e.g., sailboarding, water skiing, whitewater boating or rafting, or operating personal watercraft). If travel includes planned water activities, travelers should consider bringing their own lifejackets. Travelers also can increase the likelihood of survival in an emergency by improving their swimming skills, learning safe rescue techniques (e.g., use of poles or ropes as rescue aids so responders can avoid entering the water), and taking cardiopulmonary resuscitation (CPR) classes prior to traveling.

If overseas with children, an adult with swimming skills should be within arm's length when infants and toddlers are in or around pools and other bodies of water; even with older children and better swimmers, the supervising adult should focus on the child and not engage in any distracting activities. Travelers with children should remain vigilant, because swimming pools and ponds might not have fences around them to keep children safe. See the World Health Organization drowning resources (www.who.int/violence_injury_prevention/drowning/en) and the International Life Saving Federation (https://ilsf.org) for more information.

OTHER UNINTENTIONAL INJURIES

Adventure Activities

Adventure activities (e.g., kayaking, mountain biking and climbing, off-roading, whitewater rafting, skiing, skydiving, snowboarding) are popular among travelers. A lack of rapid emergency trauma response, inadequate trauma care in remote locations, and sudden, unexpected weather changes can compromise safety and hamper rescue efforts, delay care, and reduce survivability (see Sec. 9, Ch. 11, Adventure Travel). For recreational activities with a risk for falling, encourage travelers to use a helmet and to bring their own from home if helmets are unlikely to be available at the destination.

Aircraft Crashes

In 2017 and 2018, 25 US citizens abroad died in aircraft crashes. Travel by local, lightweight

BOX 4-11 Additional travel preparation tips for mitigating injury & trauma: a checklist for travelers

- ☐ Purchase special travel health and medical evacuation insurance if destinations include countries where access to good medical care might not be available (see Sec. 6, Ch. 1, Travel Insurance, Travel Health Insurance & Medical Evacuation Insurance).
- ☐ Learn basic first aid and CPR before traveling internationally with another person.
- ☐ Bring a travel health kit, customized to anticipated itinerary and activities.
- ☐ Review US Department of State travel advisories and alerts (www.travel.state.gov/destination) and check the US embassy or consulate (www.usembassy.gov) for country-specific personal security risks and safety tips.
- ☐ Enroll in the US Department of State's Smart Traveler Enrollment Program (https://step.state.gov/step). Enrolled travelers receive emails about safety conditions at their destination and direct embassy contact in case of natural disasters and man-made emergencies (e.g., political unrest, rioting, terrorist activity).

aircraft can be risky in many countries. Travel on unscheduled flights, in small aircraft, at night, in inclement weather, and with inexperienced pilots carries the greatest risks. Travelers should avoid using local, unscheduled, small aircraft, and refrain from flying in bad weather and at night, if possible. If available, travelers should choose larger aircraft (>30 seats), because these are more likely to have undergone stricter and more regular safety inspections. Larger aircraft also provide more protection in a crash.

Carbon Monoxide Poisoning

Carbon monoxide (CO) inhalation, poisoning, and death can occur during fires, but also can result from exposure to improperly vented heating devices. Travelers might want to bring a personal CO detector that can sound an alert in the presence of this lethal gas. Engine exhaust is a dangerous, unanticipated source of CO poisoning; remind travelers to avoid diving and swimming off the back of boats where exhaust fumes typically discharge.

Fires

In developing countries where building codes are not enforced or do not exist, fires represent a risk to traveler health and safety. Many locations have no smoke alarms or access to emergency services, and the fire department's focus is on putting out fires rather than on fire prevention or victim rescue.

To prevent fire-related injuries, travelers should select accommodations no higher than the 6th floor (fire ladders generally cannot reach higher than the 6th floor) and confirm that hotels have smoke alarms and, preferably, sprinkler systems. Suggest to travelers that they might want to bring their own smoke alarms with them, and that they should always identify ≥2 escape routes from buildings. Crawling low under smoke and covering one's mouth with a wet cloth are helpful for escaping a fire. Families should agree on a meeting place outside the building in case of a fire. The National Fire Protection Association has additional guidance (Hotel & Motel Safety) that could be useful internationally (see www.nfpa.org/-/media/Files/Public-Education/Resources/Safety-tip-sheets/HotelMotelSafety.ashx).

TRAVEL PREPARATION TIPS

When planning or arranging for a trip outside the United States, health care providers, vendors of travel services, and travelers themselves should consider taking the additional actions listed in Box 4-11.

BIBLIOGRAPHY

Balaban V, Sleet DA. Pediatric travel injuries: risk, prevention, and management. In: Kamat DM, Fischer PR, editors. American Academy of Pediatrics textbook of global child health, 2nd edition. Elk Grove Village (IL): American Academy of Pediatrics; 2015:315–38.

Cortés LM, Hargarten SW, Hennes HM. Recommendations for water safety and drowning prevention for travelers. J Travel Med. 2006;13(1):21–34.

Denny SA, Quan L, Gilchrist J, McCallin T, Shenoi R, Yusuf S, et al. Prevention of drowning. Pediatrics. 2019;143(5):e20190850.

Guse CE, Cortes LM, Hargarten SW, Hennes HM. Fatal injuries of US citizens abroad. J Travel Med. 2007;14(5):279–87.

Krug EG, Mercy JA, Dahlberg LL, Zwi AB. The world report on violence and health. Lancet. 2002;360(9339):1083–8.

McInnes RJ, Williamson LM, Morrison A. Unintentional injury during foreign travel: a review. J Travel Med. 2002;9:297–307.

US Department of State. Traveler's checklist. Available from: https://travel.state.gov/content/travel/en/international-travel/before-you-go/travelers-checklist.html.

Vann RD, Lang MA, editors. Recreational diving fatalities. Proceedings of the Divers Alert Network 2010 April 8–10 workshop. Durham (NC): Divers Alert Network; 2011.

World Health Organization. Global health estimates 2016: deaths by cause, age, sex, by country and by region, 2000–2016. Geneva: The Organization; 2018.

World Health Organization. Global report on drowning: preventing a leading killer. Geneva: The Organization; 2014. Available from: www.who.int/violence_injury_prevention/global_report_drowning/en.

DEATH DURING TRAVEL

Francisco Alvarado-Ramy, Kendra Stauffer

Death of a friend, relative, or coworker can be immensely distressing. The situation is aggravated when the death occurs abroad, where grieving individuals might be unfamiliar with local laws, language, culture, and processes for investigation and release of the body. Whether dealing with the death locally or from their home country, next of kin could face large, unanticipated costs and labor-intensive administrative requirements.

Depending on the circumstances surrounding the death, some countries require an autopsy. For travel companions of the deceased, in addition to friends and relatives, sources of support might include the US consulate or embassy, a travel insurance provider (particularly if coverage included repatriation of remains), the airline, a tour operator, faith-based and aid organizations, or the deceased person's employer. Official identification of the body will likely be needed, and official documents likely will need to be issued by the consular office. A body can be identified by witness statements of those who knew the person well, by analyzing DNA samples, by checking fingerprints, by reviewing dental radiographs, or by inspecting surgical implants.

DEATH ONBOARD A CONVEYANCE

Federal regulations require that all deaths aboard commercial flights and ships destined for the United States be reported to the Centers for Disease Control and Prevention (CDC). For details, see Guidance for Airlines on Reporting Onboard Deaths or Illnesses to CDC (www.cdc.gov/quarantine/air/reporting-deaths-illness/guidance-reporting-onboard-deaths-illnesses.html) and Guidance for Cruise Ships: How to Report Onboard Death or Illness to CDC (www.cdc.gov/quarantine/cruise/reporting-deaths-illness/guidance-how-report-onboard-death-illness.html).

Commercial Aircraft

The Federal Aviation Administration requires that flight attendants receive training in cardiopulmonary resuscitation (CPR) and in proper use of an automated external defibrillator (AED) at least once every 2 years. Under US laws, Good Samaritan laws offer protections for actions brought in a federal or state court that result from acts or omissions when people assist in a medical emergency during flight, unless there is gross negligence or willful misconduct.

If CPR is performed in an aircraft cabin for ≥30 minutes with no signs of life, and no shocks advised by an AED, the person can be presumed dead and resuscitation efforts halted. Airlines can choose to specify additional criteria for presuming death, depending on the availability of ground-to-air medical consultation services or a physician aboard the flight (see Sec. 8, Ch. 2, . . . *perspectives*: Responding to Medical Emergencies when Flying). In these cases, the body should be secured and covered for the remainder of the flight.

Cruise Ships

If death occurs on a cruise ship, the crew are usually able to provide logistical support to repatriate the body. Cruise ships are equipped with morgues and body bags and are staffed with health care professionals capable of providing clinical care. Any death involving an accident, violence, or foul play will require more extended and complicated processes. US consular officials will be able to provide general guidance and legal aid resource options (see https://travel.state.gov/content/travel/en/legal/travel-legal-considerations/internl-judicial-asst/Retaining-Foreign-Attorney.html). Some travel insurance products cover legal services abroad. Travelers should be aware of exclusions and limitations of travel insurance products prior to purchasing.

OBTAINING US DEPARTMENT OF STATE ASSISTANCE

When a US citizen dies outside the United States, the deceased person's next of kin or legal representative should notify US consular officials at the Department of State. Consular personnel are available 24 hours a day, 7 days a week, to assist US citizens during overseas emergencies.

If the next of kin or legal representative is in the foreign country with the deceased US citizen, that person should contact the nearest US embassy or consulate for assistance. Contact information for US embassies and consulates overseas can be found at the Department of State website (www.usembassy.gov).

Family members, domestic partners, or legal representatives who are in a different country from the deceased should call the Department of State's Office of Overseas Citizens Services in Washington, DC, from 8 a.m. to 5 p.m. Eastern time, Monday through Friday, at 888-407-4747 (toll-free) or 202-501-4444. For emergency assistance after working hours or on weekends and holidays, call the Department of State switchboard at 202-647-4000 and ask to speak with the Overseas Citizens Services duty officer. In addition, the US embassy closest to or in the country where the US citizen died can provide support (www.usembassy.gov).

The Department of State has no funds to assist in the return of remains of US citizens who die abroad. US consular officers assist the next of kin by conveying instructions to the appropriate offices within the foreign country and providing information to the family on how to send the necessary private funds to cover the costs of preparing and repatriating the deceased person's remains. Upon issuance of a local (foreign) death certificate, the nearest US embassy or consulate can prepare a consular report of the death of an American abroad. Copies of that report are provided to the next of kin or legal representative and can be used in US courts to settle estate matters. If the deceased person has no next of kin or legal representative in-country, a consular officer will act as a provisional conservator of the deceased person's personal effects.

IMPORTING HUMAN REMAINS FOR BURIAL, ENTOMBMENT, OR CREMATION

CDC regulates the importation of human remains and provides guidance for their importation. The requirements are more stringent if the person died from a disease classified as quarantinable in the United States (www.cdc.gov/quarantine/human-remains.html).

Except for cremated remains, human remains intended for burial, entombment, or cremation after entry into the United States must be accompanied by a death certificate stating the cause of death. A death certificate is an official government document that certifies that a death has occurred and provides identifying information about the deceased, including (at a minimum) name, age, and sex. The document must also certify the time, place, and cause of death, if known. If the official government document is not written in English,

it must be accompanied by an English language translation of the official government document, the authenticity of which must be attested to by a person licensed to perform acts in legal affairs in the country where the death occurred.

In lieu of a death certificate, a copy of the Consular Mortuary Certificate and the Affidavit of Foreign Funeral Director and Transit Permit together constitute acceptable identification of human remains. If a death certificate is not available in time for returning the remains, the US embassy or consulate should provide a Consular Mortuary Certificate stating whether the person died from a disease classified as quarantinable in the United States (www.cdc.gov/quarantine/aboutlawsregulationsquarantineisolation.html). A person transporting human remains must also meet requirements of the country of origin, air carrier, the Transportation Security Administration, and Customs and Border Protection.

EXPORTING HUMAN REMAINS

CDC does not regulate the exportation of human remains outside the United States, although other state and local regulations might apply. The United States Postal Service is the only courier legally allowed to ship cremated remains. Exporters of human remains and travelers taking human remains out of the United States should be aware that they must meet the importation requirements of the destination country. Information regarding these requirements can be obtained from the foreign embassy or consulate (see https://travel.state.gov/content/travel/en/consularnotification/ConsularNotificationandAccess.html). Air carriers also might have their own requirements, of which individuals transporting remains outside of the United States should be aware (see www.tsa.gov/travel/security-screening/whatcanibring/items/cremated-remains).

BIBLIOGRAPHY

Bureau of Consular Affairs, US State Department. Death abroad. Available from: https://travel.state.gov/content/passports/en/abroad/events-and-records/death.html.

Bureau of Consular Affairs, US State Department. Return of remains of deceased US citizens. Available from: https://travel.state.gov/content/travel/en/international-travel/while-abroad/death-abroad1/return-of-remains-of-deceased-us-citizen.html.

Centers for Disease Control and Prevention. Importation of human remains into the United States for burial, entombment, or cremation. Available from: www.cdc.gov/importation/human-remains.html.

Centers for Disease Control and Prevention. Importation of human remains final rule. Specific laws and regulations governing the control of communicable diseases. Available from: www.cdc.gov/importation/laws-and-regulations/human-remains-importation-requirements.html.

Centers for Disease Control and Prevention. Quarantine station contact list, map, and fact sheets. Available from: www.cdc.gov/quarantine/quarantinestationcontactlistfull.html

Connolly R, Prendiville R, Cusack D, Flaherty G. Repatriation of human remains following death in international travelers. J Travel Med. 2017;24(2):1–6.

International Air Transport Association. Death on board; 2018. Available from: www.iata.org/contentassets/ccbdc54681c24574bebf2db2b18197a5/death-on-board-guidelines.pdf.

National Funeral Directors Association. International shipping regulations. Available from: www.nfda.org/resources/operations-management/shipping-remains/international-shipping-regulations.

US Customs and Border Protection. What is the process for bringing bodies in coffins/ashes in urns into the United States? Available from: https://help.cbp.gov/s/article/Article-237?language=en_US.

5

Travel-Associated Infections & Diseases

CDC Yellow Book 2024. Jeffrey Nemhauser, Oxford University Press. © Oxford University Press 2023.
DOI: 10.1093/oso/9780197570944.003.0005

PART 1: BACTERIAL

Table 5-01 Vaccine-Preventable Diseases: Bacterial

VACCINE	TRADE NAME (MANUFACTURER)	DESCRIPTION[1] & ROUTE OF ADMINISTRATION	AGE LIMITS	DOSES	PRESCRIBING & BOOSTER INFORMATION, RECOMMENDATIONS & RESTRICTIONS
Anthrax	BioThrax (Emergent BioSolutions)	Cell-free filtrates of avirulent *Bacillus anthracis*, IM or SC (SC preferred)	18–65 y	3	www.fda.gov/vaccines-blood-biologics/vaccines/biothrax www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/anthrax.html
Cholera	VAXCHORA (Emergent BioSolutions)	Live-attenuated, PO	50 mL 2 to <6 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/vaxchora www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/cholera.html
			100 mL ≥6–64 y	1	
Diphtheria	For all diphtheria vaccines licensed for use in the United States, see: www.fda.gov/vaccines-blood-biologics/vaccines/vaccines-licensed-use-united-states				
	Adacel (TDaP) (Sanofi Pasteur)	Tetanus, diphtheria toxoids + acellular pertussis antigens, IM	10–64 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/adacel www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html
	BOOSTRIX (TDaP) (GlaxoSmithKline)	Tetanus, diphtheria toxoids + pertussis antigens, IM	≥10 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/boostrix www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html
	TDVAX (MassBiologics)	Tetanus, diphtheria toxoids, IM	≥7 y	3 (primary series) + 1 (booster)	www.fda.gov/vaccines-blood-biologics/vaccines/tdvax www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html
	TENIVAC (Td) (Sanofi Pasteur)	Tetanus, diphtheria toxoids, IM	≥7 y	3 (primary series) + 1 (booster)	www.fda.gov/vaccines-blood-biologics/vaccines/tenivac www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html

Meningococcal (Quadrivalent, ACWY)	Menactra (Sanofi Pasteur)	Conjugate, IM	9–23 mo	2	www.fda.gov/vaccines-blood-biologics/vaccines/menactra www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/mening.html
			≥2 y	1	
	MenQuadfi (Sanofi Pasteur)	Conjugate, IM	≥2 y	1	www.fda.gov/vaccines-blood-biologics/menquadfi www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/mening.html
	MENVEO (GlaxoSmithKline)	Conjugate, IM	2 mo	4	www.fda.gov/vaccines-blood-biologics/vaccines/menveo www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/mening.html
			3–6 mo	Depends on age at 1st vaccination	
			7–23 mo	2	
			≥2 y	1	
Meningococcal (Monovalent, B)	BEXSERO (GlaxoSmithKline)	Recombinant, IM	10–25 y	2	www.fda.gov/vaccines-blood-biologics/vaccines/bexsero www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/mening.html
	TRUMENBA (Pfizer)	Recombinant, IM	10–25 y	2	www.fda.gov/vaccines-blood-biologics/vaccines/trumenba www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/mening.html
Pertussis	For all pertussis vaccines licensed for use in the United States, see: www.fda.gov/vaccines-blood-biologics/vaccines/vaccines-licensed-use-united-states				
	Adacel (TDaP) (Sanofi Pasteur)	Tetanus, diphtheria toxoids + acellular pertussis antigens, IM	10–64 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/adacel www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html
	BOOSTRIX (TDaP) (GlaxoSmithKline)	Tetanus, diphtheria toxoids + pertussis antigens, IM	≥10 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/boostrix www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html

(*continued*)

Table 5-01 Vaccine-Preventable Diseases: Bacterial (continued)

VACCINE	TRADE NAME (MANUFACTURER)	DESCRIPTION[1] & ROUTE OF ADMINISTRATION	AGE LIMITS	DOSES	PRESCRIBING & BOOSTER INFORMATION, RECOMMENDATIONS & RESTRICTIONS
Plague	Discontinued in 1999; newer vaccines in development, none commercially available or FDA-approved				
Pneumococcal	PREVNAR 13 (Wyeth)	Conjugate, IM	6 wk to <6 y	4	www.fda.gov/vaccines-blood-biologics/vaccines/prevnar-13 www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/pneumo.html
			6 y to <18 y	1	
	VAXNEUVANCE (Merck)	Conjugate, IM	≥18 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/vaxneuvance www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/pneumo.html
	PREVNAR 20 (Wyeth)	Conjugate, IM	≥18 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/prevnar-20 www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/pneumo.html
	PNEUMOVAX 23 (Merck)	Polysaccharide, IM or SC	≥50 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/pneumovax-23-pneumococcal-vaccine-polyvalent www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/pneumo.html
Q Fever	Available in Australia only				
Tetanus	For all tetanus vaccines licensed for use in the United States, see: www.fda.gov/vaccines-blood-biologics/vaccines/vaccines-licensed-use-united-states				
	Adacel (TDaP) (Sanofi Pasteur)	Tetanus, diphtheria toxoids + acellular pertussis antigens, IM	10–64 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/adacel www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html
	BOOSTRIX (TDaP) (GlaxoSmithKline)	Tetanus, diphtheria toxoids + pertussis antigens, IM	≥10 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/boostrix www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html

	TDVAX (MassBiologics)	Tetanus, diphtheria toxoids, IM	≥7 y	3 (primary series) + 1 (booster)	www.fda.gov/vaccines-blood-biologics/vaccines/tdvax www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html
	TENIVAC (Td) (Sanofi Pasteur)	Tetanus, diphtheria toxoids, IM	≥7 y	3 (primary series) + 1 (booster)	www.fda.gov/vaccines-blood-biologics/vaccines/tenivac www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/dtap.html
Tuberculosis	bacillus Calmette-Guérin (BCG) is no longer commercially available in the United States				
Typhoid fever	Typhim Vi (Sanofi Pasteur)	Polysaccharide, IM	≥2 y	1	www.fda.gov/vaccines-blood-biologics/vaccines/typhim-vi www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/typhoid.html
	Vivotif (Emergent BioSolutions)	Live-attenuated, PO	≥6 y	4	https://vivotif.com/downloads/Vivotif_Prescribing_Information_2017.pdf www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/typhoid.html

Abbreviations: IM, intramuscular; PO, orally; SC, subcutaneously
[1]For an overview and description of vaccine types, see: www.hhs.gov/immunization/basics/types/index.html

ANTHRAX

Kate Hendricks, Antonio Vieira, Rita Traxler, Chung Marston

INFECTIOUS AGENT: *Bacillus anthracis*	
ENDEMICITY	Enzootic and endemic to agricultural regions in sub-Saharan Africa, Central and South America, central and southwestern Asia, and southern and eastern Europe Enzootic but not endemic to the United States, Canada, and western Europe
TRAVELER CATEGORIES AT GREATEST RISK FOR EXPOSURE & INFECTION	Adventure tourists Immigrants and refugees Military personnel Scientists conducting anthrax fieldwork
PREVENTION METHODS	In enzootic areas, avoid direct or indirect contact with animals and animal products, trophies, souvenirs Comply with regulations and restrictions against importing prohibited animal products, trophies, and souvenirs Scientists conducting anthrax fieldwork should obtain preexposure vaccination and use personal protective equipment
DIAGNOSTIC SUPPORT	A clinical laboratory certified in high complexity testing; state health department; CDC's Bacterial Special Pathogens Branch (bspb@cdc.gov); or CDC Emergency Operations Center (770-488-7100)

INFECTIOUS AGENT

Anthrax is caused by aerobic, gram-positive, encapsulated, spore-forming, nonmotile, nonhemolytic, rod-shaped bacterium, *Bacillus anthracis*.

TRANSMISSION

Most human infections with *B. anthracis* result from handling *B. anthracis*–infected animals or their carcasses, meat, hides, or wool. Products derived from infected animals (e.g., drumheads, wool clothing) are additional documented sources of human infection.

Anthrax infection can occur via cutaneous, ingestion, injection, and inhalation routes. Spores introduced through the skin can result in cutaneous anthrax; breaks in the skin increase susceptibility. Eating meat from infected animals can result in ingestion (also called gastrointestinal) anthrax. Since 2000, injection transmission has been reported in cases of *B. anthracis* soft-tissue infections among intravenous heroin users in northern Europe. Aerosolized spores from contaminated hides or wool can cause inhalation anthrax. Anthrax in humans generally is not considered contagious; person-to-person transmission of cutaneous anthrax has been reported only rarely and only in instances of extremely close contact with an infected person (e.g., breastfeeding, dressing a wound, direct skin contact with the blood from a patient with anthrax).

EPIDEMIOLOGY

Anthrax is a zoonotic disease primarily affecting ruminant herbivores (e.g., antelope, cattle, deer, goats, sheep) that become infected by ingesting vegetation, soil, or water that has been contaminated with *B. anthracis* spores; humans are generally incidental hosts. Anthrax is most common in agricultural regions in sub-Saharan Africa, Central and South America, central and southwestern Asia, and southern and eastern Europe. Although outbreaks still occur in livestock and wild herbivores in Canada, the United States, and western Europe, human anthrax in these areas is now rare.

Worldwide, the most reported form of anthrax in humans is cutaneous anthrax (95%–99%). Anthrax can occur after playing or handling drums made from contaminated goatskins. Although the risk of acquiring anthrax from drums imported from anthrax-endemic countries appears low, life-threatening or fatal disease is possible. Cases of cutaneous (n=4), ingestion (n=1), and inhalation (n=3) anthrax have been reported in people who have handled, played, or made such drums; bystanders to such indoor activities have rarely been infected.

Outbreaks of cutaneous and ingestion anthrax have been associated with handling infected animals and butchering and eating meat from those animals. Most of these outbreaks have occurred in endemic areas in Africa and Asia. A handful of cutaneous cases have been reported in travelers with direct or indirect contact with animals or their byproducts. One instance occurred in a tourist who traveled to Namibia, Botswana, and South Africa in 2006; another, in a traveler to Turkey in 2018. A third case happened in a scientist who was conducting anthrax fieldwork in Namibia, also in 2018.

Severe soft-tissue infections, including cases complicated by sepsis and systemic infection, are suspected to be due to recreational use of heroin contaminated with *B. anthracis* spores. No associated cases have been identified in people who have not injected heroin.

Inhalation exposure was historically associated with the industrial processing of hides or wool. More recently, bioterrorist activities directed toward the American public were implicated as a source of inhalation exposure. Occasional anthrax cases have occurred in the United States and elsewhere, in which the exposure source remains unidentified.

Travelers are at greatest risk for infection in areas where the disease is more prevalent. Destination categories that increase risk for infection include safari areas where direct contact with animals or carcasses might occur; regions with limited meat inspections and processing capacity; and areas where travelers are exposed to livestock byproducts (e.g., souvenirs). Immigrants and refugees in areas of low socioeconomic development and limited food availability also might be at increased risk of contracting anthrax due to lack of proper inspection of meat and animal products.

CLINICAL PRESENTATION

Anthrax has 4 main clinical presentations—cutaneous, ingestion, injection, and inhalation. Anthrax meningitis can complicate any of the 4 main clinical presentations and can occur with no obvious portal of entry, in which case it is called primary anthrax meningitis.

Cutaneous Anthrax

Cutaneous anthrax usually develops 1–7 days after exposure, but incubation periods up to 17 days have been reported. Before antimicrobial therapy became available, almost a quarter of patients with cutaneous anthrax died. The case-fatality ratio is <2% with antimicrobial therapy.

Localized itching, followed by development of a painless papule, heralds cutaneous anthrax. The papule then turns into a vesicle that enlarges and ulcerates, ultimately becoming a depressed black eschar 7–10 days after the appearance of the initial lesion. Edema around lesions is characteristic, sometimes with secondary vesicles, hyperemia, and regional lymphadenopathy. Head, neck, forearms, and hands are the most common sites affected. Patients might have malaise and headache; about one-third are febrile.

Ingestion Anthrax

Ingestion anthrax usually develops 1–7 days after eating contaminated meat; incubation periods up to 16 days have been reported, however. Left untreated, more than half of cases will die; with treatment, the case-fatality ratio decreases slightly, to <40%. Ingestion anthrax has 2 main types: oropharyngeal and intestinal. Patients with either form usually have fever and chills.

Oropharyngeal anthrax is characterized by severe sore throat, difficulty swallowing, swelling of the neck, and regional lymphadenopathy; airway compromise and death can occur. Nausea, vomiting, and diarrhea, which might be bloody, are more typical of intestinal anthrax; marked ascites or coagulopathy also can develop. Later symptoms can include shortness of breath and altered mental status, with shock and death occurring 2–5 days after disease onset.