

Environmental health risks

Travellers often experience abrupt and dramatic changes in environmental conditions, which may have detrimental effects on health and well-being. Travel may involve major changes in altitude, temperature and humidity, and exposure to microbes, animals and insects. The negative impact of sudden changes in the environment can be minimized by taking simple precautions.

Altitude

Barometric pressure falls with increasing altitude, diminishing the partial pressure of oxygen and causing hypoxia. The partial pressure of oxygen at 2500 m, the altitude of Vail, Colorado, for example, is 26% lower than at sea level; in La Paz, Bolivia (4000 m), it is 41% lower. This places a substantial stress on the body, which requires at least a few days to acclimatize; the extent of acclimatization may be limited by certain medical conditions, especially lung disease. An increase in alveolar oxygen through increased ventilation is the key to acclimatization; this process starts at 1500 m. Despite successful acclimatization, aerobic exercise performance remains impaired and travellers may still experience problems with sleep.

High-altitude illness (HAI) results when hypoxic stress outstrips acclimatization. HAI can occur at any altitude above 2100 m, but is particularly common above 2750 m. In Colorado ski resorts, incidence of HAI varies from 15% to 40%, depending on sleeping altitude. Susceptibility is primarily genetic, but fast rates of ascent and higher sleeping altitudes are important precipitating factors. Age, sex and physical fitness have little influence.

The spectrum of HAI includes common acute mountain sickness (AMS), occasional high-altitude pulmonary oedema and, rarely, high altitude cerebral oedema. The latter two conditions, although uncommon, are potentially fatal. AMS may occur after 1–12 hours at high altitude. Headache is followed by anorexia, nausea, insomnia, fatigue and lassitude. Symptoms usually resolve spontaneously in 24–48 hours and are ameliorated by oxygen or analgesics and antiemetics. Acetazolamide 5 mg/kg per day in divided doses is an effective chemoprophylaxis for all HAI; it is started one day before travel to altitude and continued for the first two days at altitude. Acetazolamide should be avoided in persons with allergies to sulfa drugs.

Only a few conditions are contraindications for travel to altitude; they include unstable angina, pulmonary hypertension, severe chronic obstructive pulmonary disease (COPD) and sickle-cell disease. Patients with stable coronary disease, hypertension, diabetes, asthma or mild COPD, and pregnant women generally tolerate altitude well but may require monitoring of their condition. Portable and stationary oxygen supplies are readily available in most high-altitude resorts and – by removing hypoxic stress – remove any potential danger from altitude exposure.

Precautions for travellers unaccustomed to high altitudes

- | Avoid one-day travel to sleeping altitudes over 2750 m if possible. Break the journey for at least one night at 2000–2500 m to help prevent AMS.
- | Avoid overexertion and alcohol for the first 24 hours at altitude, drink extra water.
- | If direct travel to sleeping altitude over 2750 m is unavoidable, consider prophylaxis with acetazolamide.
- | Acetazolamide is also effective if started early in the course of AMS.
- | Travellers planning to climb or trek at high altitude will require a period of gradual acclimatization.
- | Travellers with pre-existing cardiovascular or pulmonary disease should seek medical advice before travelling to high altitudes.
- | Travellers with the following symptoms should seek medical attention when, at altitude:
 - symptoms of AMS that are severe or last longer than 2 days
 - progressive shortness of breath with cough and fatigue
 - ataxia or altered mental status.

Heat and humidity

Sudden changes in temperature and humidity may have adverse effects on health. Exposure to high temperature and humidity results in loss of water and electrolytes (salts) and may lead to heat exhaustion and heat stroke. In hot dry conditions, dehydration is particularly likely to develop unless care is taken to maintain adequate fluid intake. The addition of a little table salt to food or drink (unless this is contraindicated for the individual) can help to prevent heat exhaustion, particularly during the period of adaptation.

Consumption of salt-containing food and drink helps to replenish the electrolytes in case of heat exhaustion and after excessive sweating. Older travellers should take particular care to consume extra fluids in hot conditions, as the thirst reflex diminishes with age. Care should be taken to ensure that infants and young children drink enough liquid to avoid dehydration.

Irritation of the skin may be experienced in hot conditions (prickly heat). Fungal skin infections such as tinea pedis (athlete's foot) are often aggravated by heat and humidity. A daily shower, wearing loose cotton clothing and applying talcum powder to sensitive skin areas help to reduce the development or spread of these infections.

Exposure to hot, dry, dusty air may lead to irritation and infection of the eyes and respiratory tract.

Ultraviolet radiation from the sun

The ultraviolet (UV) radiation from the sun includes UVA (wavelength 315–400 nm) and UVB (280–315 nm) radiation, both of which are damaging to human skin and eyes. The intensity of UV radiation is indicated by the Global Solar UV Index, which is a measure of skin-damaging radiation. The Index describes the level of solar UV radiation at the Earth's surface and is often reported as the maximum 10–30-minute average for the day. The values of the Index range from zero upwards—the higher the Index value, the greater the potential for damage to the skin and eyes, and the less time it takes for harm to occur. The Index values are grouped into exposure categories, with values greater than 10 being “extreme”. In general, the closer to the equator the higher the Index. UVB radiation is particularly intense in summer and in the 4-hour period around solar noon. UV radiation may penetrate clear water to a depth of 1 metre or more.

The adverse effects of ultraviolet radiation from the sun are the following:

- | Exposure to UV radiation, particularly UVB, can produce severe debilitating sunburn and sunstroke, particularly in light-skinned people.
- | Exposure of the eyes may result in acute keratitis (“snow blindness”), and long-term damage leads to the development of cataracts.
- | Long-term adverse effects on the skin include:
 - the development of skin cancers (carcinomas and malignant melanoma), mainly due to UVB radiation;
 - accelerated ageing of the skin, mainly due to UVA radiation, which penetrates more deeply into the skin.
- | Adverse reactions of the skin result from interaction with a wide range of medicinal drugs that may cause photosensitization and result in phototoxic or photoallergic dermatitis. A variety of different types of therapeutic drugs as well as oral contraceptives, some prophylactic antimalarial drugs and certain antimicrobials may cause adverse dermatological reactions on exposure to sunlight. Phototoxic contact reactions are caused by topical application of products, including perfumes, containing oil of bergamot or other citrus oils.
- | Exposure may suppress the immune system, increase the risk of infectious disease, and limit the efficacy of vaccinations.

Precautions

- | Avoid exposure to the sun in the middle of the day, when the UV intensity is greatest.
- | Wear clothing that covers arms and legs (summer clothing is UV-protective and generally more effective than even good-quality sunscreen).
- | Wear UV-protective sunglasses of wrap-around design and a wide-brimmed sun hat.
- | Apply a broad-spectrum sunscreen of sun protection factor (SPF) 15+ liberally on areas of the body not protected by clothing and reapply frequently.
- | Take particular care to ensure that children are well protected.
- | Take precautions against excessive exposure on or in water.
- | Check that medication being taken will not affect sensitivity to UV radiation.
- | If adverse skin reactions have occurred previously, avoid any exposure to the sun and avoid any products that have previously caused the adverse reactions.

Foodborne and waterborne health risks

Many important infectious diseases (such as brucellosis, cholera, cryptosporidiosis, giardiasis, hepatitis A and E, legionellosis, leptospirosis, listeriosis, schistosomiasis and typhoid fever) are transmitted by contaminated food and water. Information on these and other specific infectious diseases of interest for travellers is provided in Chapter 5.

For travellers, the main health problem associated with contaminated food and water is “travellers’ diarrhoea”, which can be caused by a wide range of infectious agents. Travellers’ diarrhoea is the most common health problem encountered by travellers and may affect up to 80% of travellers to high-risk destinations. Even a brief episode of severe diarrhoea may spoil a holiday or ruin a business trip. Diarrhoea may be accompanied by nausea, vomiting and fever. Travellers’ diarrhoea is primarily the result of consumption of contaminated food, drink or drinking-water. Contamination in such cases is due to the presence of disease-producing microorganisms. A wide range of different bacteria and viruses, and some parasitic and fungal infections may cause travellers’ diarrhoea.

Illness is also caused by certain biological toxins found in seafood. The main diseases in this group are caused by poisoning from:

- paralytic shellfish
- neurotoxic shellfish
- amnesic shellfish
- ciguatera toxin
- scombroid fish
- puffer fish.

The toxins involved in these poisonings come from microorganisms consumed by or otherwise contaminating the fish.

Poisonous chemicals may also contaminate food and drink. However, the ill-effects are generally the result of long-term exposure and do not represent a significant health risk for travellers. Sporadic misuse of chemicals also occurs, such as the use of textile dyes in foodstuffs, which may give an unusually bright colour to the contaminated food.

The safety of food, drink and drinking-water depends mainly on the standards of hygiene applied locally in their preparation and handling. In countries with low standards of hygiene and sanitation and poor infrastructure for controlling the safety of food, drink and drinking-water, there is a high risk of contracting travellers’ diarrhoea. In such countries, travellers should take precautions with **all** food and drink, including that

served in good-quality hotels and restaurants, to minimize any risk of contracting a foodborne or waterborne infection. While the risks are greater in poor countries, locations with poor hygiene may be present in any country. Another potential source of waterborne infection is contaminated recreational water (see next section),

It is particularly important that people in more vulnerable groups, i.e. infants and children, the elderly, pregnant women and people with impaired immune systems, take stringent precautions to avoid contaminated food and drink and unsafe recreational waters.

Precautions for avoiding unsafe food and drink

- | Avoid cooked food that has been kept at room temperature for several hours.
- | Eat only food that has been cooked thoroughly and is still hot.
- | Avoid uncooked food, apart from fruit and vegetables that can be peeled or shelled, and avoid fruits with damaged skins.
- | Avoid dishes containing raw or undercooked eggs.
- | Avoid food bought from street vendors.
- | Avoid ice cream from unreliable sources, including street vendors.
- | In countries where poisonous biotoxins may be present in fish and shellfish, obtain advice locally.
- | Boil unpasteurized (raw) milk before consumption.
- | Boil drinking-water if its safety is doubtful; if boiling is not possible, a certified, well-maintained filter and/or a disinfectant agent can be used.
- | Avoid ice unless it has been made from safe water.
- | Avoid brushing the teeth with unsafe water.
- | Bottled or packaged cold drinks are usually safe provided that they are sealed; hot beverages are usually safe.

Treating water of questionable quality

- | Bringing water to a rolling boil is the most effective way to kill all disease-causing pathogens. Let the hot water cool down on its own without adding ice (as one cannot be sure if the ice itself is safe).
- | If it is not possible to boil water, chemical disinfection of clear, non-turbid water is effective for killing bacteria and viruses and some protozoa (but not, for example, *Cryptosporidium*). Chlorine and iodine are the chemicals most commonly used for disinfection.
- | A product that combines chlorine disinfection with coagulation/flocculation (i.e., chemical precipitation) should be used, when available, as these products remove significant numbers of protozoa, in addition to killing bacteria and viruses.
- | If turbid water (i.e. not clear, or with suspended solid matter) is to be disinfected with chemicals, it should be cleared beforehand, for example by letting the impurities settle or by filtering.
- | Portable point-of-use (POU) devices tested and rated to remove protozoa and some bacteria are also available. Ceramic, membrane and carbon-block filters are the most common types. Selecting the most appropriate filter pore size is crucial; a size of 1 μm or less for the filter media pore is recommended to ensure removal of *Cryptosporidium* in clear water.
- | Unless water is boiled, a combination of methods (e.g. filtration followed by chemical disinfection or boiling) is recommended, since most POU filtration devices do not remove nor kill viruses. Reverse osmosis (very fine pore filtration that holds back dissolved salts in the water) and ultrafiltration (fine pore filtration that passes dissolved salts but holds back viruses and other microbes) devices can theoretically remove all pathogens.
- | Often, after chemical treatment, a carbon filter is used to improve taste and, in the case of iodine treatment, to remove excess iodine.

Treatment of diarrhoea

Most diarrhoeal episodes are self-limiting, with recovery in a few days. It is important, especially for children, to avoid becoming dehydrated.

As soon as diarrhoea starts, more fluids should be taken, such as safe water (bottled, boiled or chlorinated). If diarrhoea continues for more than one day, oral rehydration salt (ORS) solution should be taken and normal food consumption should continue.

Amounts of ORS solution to drink

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| Children under 2 years | $\frac{1}{4}$ – $\frac{1}{2}$ cup (50–100 ml) after each loose stool up to approximately 0.5 litre a day. |
| Children 2–9 years | $\frac{1}{2}$ –1 cup (100–200 ml) after each loose stool up to approximately 1 litre a day. |
| Patients of 10 years or older | As much as wanted, up to approximately 2 litres a day. |

If ORS solution is not available, a substitute containing 6 level teaspoons of sugar plus 1 level teaspoon of salt in 1 litre of safe drinking-water can be used, in the same amounts as for ORS. (A level teaspoon contains a volume of 5 ml.)

Medical help should be sought if diarrhoea lasts for more than 3 days and/or there are very frequent watery bowel movements, blood in the stools, repeated vomiting or fever.

When medical help is not available, first-line antibiotics such as fluoroquinolones (e.g. ciprofloxacin or levofloxacin) can be used as empirical therapy. However, increasing resistance to fluoroquinolones, especially among *Campylobacter* isolates, may lower their efficacy in some parts of the world, particularly in Asia. In such cases, azithromycin can be taken as an alternative treatment. Azithromycin is also the first-line antibiotic therapy for children and pregnant women. When immediate relief of diarrhoea is needed in travellers, antidiarrhoeal drugs such as loperamide may be additionally used, but such antimotility drugs are contraindicated in children.

Prophylactic use of antibiotics is not recommended. Prophylactic use of antidiarrhoeal medicines is always contraindicated.

Breastfeeding should not be interrupted.

In case of any other symptoms, medical advice should be sought rapidly.

Recreational waters

The use of coastal waters and freshwater lakes and rivers for recreational purposes has a beneficial effect on health through exercise, and rest and relaxation. However, various hazards to health may also be associated with recreational waters. The main risks are the following:

- | Drowning and injury (see Chapter 4).
- | Physiological:
 - chilling, leading to coma and death;
 - thermal shock, leading to cramps and cardiac arrest;
 - acute exposure to heat and ultraviolet radiation in sunlight: heat exhaustion, sunburn, sunstroke;
 - cumulative exposure to sun (skin cancers, cataract).
- | Infection:
 - ingestion or inhalation of, or contact with, pathogenic bacteria, fungi, parasites and viruses;
 - bites by mosquitoes and other insect vectors of infectious diseases.
- | Poisoning and toxicoses:
 - ingestion or inhalation of, or contact with, chemically contaminated water, including oil slicks;
 - stings or bites of venomous animals;
 - ingestion or inhalation of, or contact with, blooms of toxigenic plankton.

Exposure to cold: immersion hypothermia

Cold, rather than simple drowning, is the main cause of death at sea. When the body temperature falls (hypothermia), there is confusion followed by loss of consciousness, so that the head goes under water leading to drowning. With a life jacket capable of keeping the head out of water, drowning is avoided, but death due directly to hypothermic cardiac arrest will soon follow. However, wearing warm clothing as well as a life jacket can greatly prolong survival in cold water. Children, particularly boys, have less fat than adults and chill very rapidly in cool or cold water.

Swimming is difficult in very cold water (around 0 °C), and even good swimmers often drown suddenly if they attempt to swim even short distances in water at these temperatures without a life jacket. Life jackets or some other form of flotation aid should always be worn in small craft, particularly by children and young men, when the water is cold.

Alcohol, even in small amounts, can cause hypoglycaemia if consumed without food and after exercise. It causes confusion and disorientation and also, in cold surroundings, a rapid fall in body temperature. Unless sufficient food is eaten at the same time, small amounts of alcohol can be exceedingly dangerous on long-distance swims, as well as after rowing or other strenuous and prolonged water-sports exercise.

Those engaging in winter activities on water, such as skating and fishing, should be aware that whole-body immersion must be avoided. Accidental immersion in water at or close to freezing temperatures is dangerous because the median lethal immersion time (time to death) is less than 30 minutes for children and most adults.

Immediate treatment is much more important than any later action in reviving victims of immersion hypothermia. A hot bath (the temperature no higher than the immersed hand will tolerate) is the most effective method of achieving this. In case of drowning, cardiac arrest and cessation of breathing should be treated by tipping water out of the stomach and giving immediate external cardiac massage and artificial ventilation. Cardiac massage should not be applied unless the heart has stopped. People who have inhaled water should always be sent to hospital to check for pulmonary complications.

Infection

In coastal waters, infection may result from ingestion or inhalation of, or contact with, pathogenic microorganisms, which may be naturally present, carried by people or animals using the water, or present as a result of faecal contamination. The most common consequences among travellers are diarrhoeal disease, acute febrile respiratory disease and ear infections. Corals can result in skin abrasions that are frequently contaminated by live coral organisms and severe skin infections can ensue quickly.

In fresh waters, leptospirosis may be spread by the urine of infected rodents, causing human infection through contact with broken skin or mucous membranes. In areas endemic for schistosomiasis, infection may be acquired by penetration of the skin by larvae during swimming or wading. (See also Chapter 5.)

In swimming pools and spas, infection may occur if treatment and disinfection of the water are inadequate. Diarrhoea, gastroenteritis and throat infections may result from contact with contaminated water. Appropriate use of chlorine and other disinfectants controls most viruses and bacteria in water. However, the parasites *Giardia* and *Cryptosporidium*, which are shed in large numbers by infected individuals, are highly resistant to routine disinfection procedures. They are inactivated by ozone or eliminated by filtration.

Contamination of spas and whirlpools may lead to infection by *Legionella* and *Pseudomonas aeruginosa*. Otitis externa and infections of the urinary tract, respiratory tract, wounds and cornea have also been linked to spas.

Direct person-to-person contact or physical contact with contaminated surfaces in the vicinity of pools and spas may spread the viruses that cause molluscum contagiosum and cutaneous papillomas (warts); fungal infections of the hair, fingernails and skin, notably tinea pedis (athlete's foot), are spread in a similar manner.

Precautions

- | Adopt safe behaviour in all recreational waters (see Chapter 4).
- | Avoid consumption of alcohol before any activities in or near recreational waters.
- | Provide constant supervision of children in the vicinity of recreational waters.
- | Avoid temperature extremes in spas, saunas, etc; this is particularly important for users with pre-existing medical conditions, pregnant women and young children.
- | Avoid excessive exposure to sunlight.
- | Avoid contact with contaminated waters.
- | Avoid swallowing any contaminated water.
- | Apply antiseptic to coral cuts and abrasions.
- | Obtain advice locally about the presence of potentially dangerous aquatic animals.
- | Wear shoes when walking on shores, riverbanks and muddy terrain.

Animals and insects

Mammals

Animals tend to avoid contact with humans and most do not attack unless provoked. Some large carnivores, however, are aggressive and may attack. Animals suffering from rabies often become aggressive and may attack without provocation. Wild animals may become aggressive if there is territorial intrusion, particularly when the young are being protected. Animal bites may cause serious injury and may also result in transmission of disease.

Rabies is the most important infectious health hazard from animal bites. In many developing countries, rabies is transmitted mainly by dogs, but many other species of mammals can be infected by the rabies virus. After any animal bite, the wound should be thoroughly cleansed with disinfectant or with soap or detergent and water, and medical or veterinary advice should be sought about the possibility of rabies in the area. Where a significant risk of rabies exists, the patient should be treated with post-exposure rabies vaccination and immunoglobulin (see Chapter 5). A booster dose of tetanus toxoid is also recommended following an animal bite.

Travellers who may be at increased risk of exposure to rabies may be advised to have pre-exposure vaccination before departure (see Chapter 6). Pre-exposure rabies vaccination does not eliminate the need for treatment after the bite of a rabid animal, but it reduces the number of vaccine doses required in the post-exposure regimen.

Precautions

- | Avoid direct contact with domestic animals in areas where rabies occurs, and with all wild and captive animals.
- | Avoid behaviour that may startle, frighten or threaten an animal.
- | Ensure that children do not approach, touch or otherwise provoke any animal.
- | Treat any animal bite immediately by washing with disinfectant or soap and seek medical advice.
- | If a significant risk of exposure to rabies is foreseen, seek medical advice before travelling.

Travellers with accompanying animals should be aware that dogs (and, for some countries, cats) must be vaccinated against rabies in order to be allowed to cross international borders. A number of rabies-free countries have additional requirements. Before taking an animal abroad, the traveller should ascertain the regulatory requirements of the countries of destination and transit.

Snakes, scorpions and spiders

Travellers to tropical, subtropical and desert areas should be aware of the possible presence of venomous snakes, scorpions and spiders. Local advice should be sought about risks in the areas to be visited. Most venomous species are particularly active at night.

Venom from snake and spider bites and from scorpion stings has various effects in addition to tissue damage in the vicinity of the bite. Neurotoxins are present in the venom of both terrestrial and aquatic snakes, and also often in the venom of scorpions and spiders. Neurotoxins cause weakness and paralysis and other symptoms. Venom contacting the eyes causes severe damage and may result in blindness. Most snake venoms affect blood coagulation, which may result in haemorrhage and reduced blood pressure. Toxins in the hair of spiders such as tarantulas may cause intense irritation on contact with the skin.

Poisoning by a venomous snake, scorpion or spider is a medical emergency requiring immediate attention. The patient should be moved to the nearest medical facility as quickly as possible. First-aid measures call for immobilizing the entire affected limb with splints and firm, but not tight, bandaging to limit the spread of toxin in the body and the amount of local tissue damage. However, bandaging is not recommended if local swelling and tissue damage are present in the vicinity of the bite. Other traditional first-aid methods (incisions and suction, tourniquets and compression) are harmful and should not be used.

The decision to use antivenom should be taken only by qualified medical personnel, and it should be administered in a medical facility. Antivenom should be given only if its stated range of specificity includes the species responsible for the bite.

Precautions

- 1 Obtain local advice about the possible presence of venomous snakes, scorpions and spiders in the area.
- 1 Avoid walking barefoot or in open sandals in terrain where venomous snakes, scorpions or spiders may be present; wear boots or closed shoes and long trousers.
- 1 Avoid placing hands or feet where snakes, spiders or scorpions may be hiding.
- 1 Be particularly careful outdoors at night.
- 1 Examine clothing and shoes before use for hidden snakes, scorpions or spiders.

Aquatic animals

Swimmers and divers may be bitten by certain aquatic animals, including conger and moray eels, stingrays, weever fish, scorpionfish, stonefish, piranhas, seals and sharks. They may be stung by venomous cnidaria—jellyfish, fire corals, sea anemones—and other invertebrate aquatic species including octopus. Severe and often fatal injury results from attack by crocodiles, which inhabit rivers and estuaries in many tropical countries, including the tropical north of Australia. Injuries from dangerous aquatic organisms occur as a result of:

- passing close to a venomous organism while bathing or wading;
- treading on a stingray, weever fish or sea urchin;
- handling venomous organisms during sea-shore exploration;
- invading the territory of large animals when swimming or at the water's edge;
- swimming in waters used as hunting grounds by large predators;
- interfering with, or provoking, dangerous aquatic organisms.

Precautions

- 1 Obtain local advice on the possible presence of dangerous aquatic animals in the area.
- 1 Adopt behaviour that will avoid provoking attack by predatory animals.
- 1 Wear shoes when walking on the shore and at the water's edge.
- 1 Avoid contact with jellyfish in water and dead jellyfish on the beach.
- 1 Avoid walking, wading or swimming in crocodile-infested waters at all times of year.
- 1 Seek medical advice after a sting or bite by a poisonous animal.

Treatment

In the case of envenomings by aquatic animals, treatment will depend on whether there is a wound or puncture or a localized skin reaction (e.g. rash). Punctures caused by spiny fish require immersion in hot water, extraction of the spines, careful cleaning of the wound and antibiotic therapy (and antivenom in the case of stonefish). If punctures were caused by an octopus or sea urchin the treatment is basically the same but without exposure to heat. In the case of rashes or linear lesions, contact with cnidaria should be suspected; the treatment is based on the use of 5% acetic acid, local decontamination and corticosteroids (antivenom for the box jellyfish *Chironex fleckeri*), with adequate follow-up for eventual sequelae.

Insects and other vectors of disease

Vectors play an essential role in the transmission of many infectious diseases. Many vectors are bloodsucking insects, which ingest the disease-producing microorganism during a blood meal from an infected host (human or animal) and later inject it into a new host at the time of another blood meal. Mosquitoes are important insect vectors of disease, and some diseases are transmitted by bloodsucking flies. In addition, ticks and certain aquatic snails are involved in the life cycle and transmission of disease. The principal vectors and the main diseases they transmit are shown in Table 3.1 at the end of this chapter. Information about the diseases and specific preventive measures are provided in Chapters 5, 6 and 7.

Water plays a key role in the life cycle of most vectors. Thus, the transmission of many vector-borne diseases is seasonal as there is a relationship between rainfall and the existence of breeding sites. Temperature is also a critical factor, limiting the distribution of vectors by altitude and latitude.

Travellers are usually at lower risk of exposure to vector-borne diseases in urban centres, especially if they sleep in air-conditioned rooms. They may, however, be exposed to the vectors of dengue which are frequent in urban centres in tropical countries and which bite mostly during the day. Travellers to rural areas or to areas with low standards of hygiene and sanitation are usually at higher risk of exposure to disease vectors and personal protection is therefore essential. Evening/night-time activities outdoors may increase exposure to malaria vectors.

Protection against vectors

Travellers may protect themselves from mosquitoes and other vectors by the means outlined in the following paragraphs.

Insect repellents are substances applied to exposed skin or to clothing to prevent human/vector contact. The active ingredient in a repellent repels but does not kill insects. Choose a repellent containing DEET (N, N-diethyl- 3-methylbenzamide), IR3535 (3-[N-acetyl-N-butyl]-aminopropionic acid ethyl ester) or Icaridin (1-piperidinecarboxylic acid, 2-(2-hydroxyethyl)-1-methylpropylester). Insect repellents should be applied to provide protection at times when insects are biting. Care must be taken to avoid contact with mucous membranes. Insect repellents should not be sprayed on the face or applied to the eyelids or lips. Always wash the hands after applying the repellent. Insect repellents should not be applied to sensitive, sunburned or damaged skin or deep skin folds. Repeated applications may be required every 3–4 hours, especially in hot and humid climates. When the product is applied to clothes, the repellent effect lasts longer. Repellents should be used in strict accordance with the manufacturers' instructions and the dosage must not be exceeded, especially for young children and pregnant women.

Mosquito nets are excellent means of personal protection while sleeping. Nets can be used either with or without insecticide treatment. However, treated nets are much more effective. Pretreated nets may be commercially available. Nets should be strong and with a mesh size no larger than 1.5 mm. The net should be tucked in under the mattress, ensuring first that it is not torn and that there are no mosquitoes inside. Nets for hammocks are available, as are nets for cots and small beds.

Mosquito coils are the best known example of insecticide vaporizer, usually with a synthetic pyrethroid as the active ingredient. One coil serves a normal bedroom through the night, unless the room is particularly draughty. A more sophisticated version, which requires electricity, is an insecticide mat that is placed on an electrically heated grid, causing the insecticide to vaporize. Such devices can also be used during daytime if necessary.

Aerosol sprays intended to kill flying insects are effective for quick knockdown and killing. Indoor sleeping areas should be sprayed before bedtime. Treating a room with an insecticide spray will help to free it from insects, but the effect may be short-lived. Spraying combined with the use of a coil, a vaporizer or a mosquito net is recommended. Aerosol sprays intended for crawling insects (e.g. cockroaches and ants) should be sprayed on surfaces where these insects walk.

Protective clothing can help at times of the day when vectors are active. The thickness of the material is critical. Exposed skin should be treated with a repellent. Insect repellent applied to clothing is effective for longer than it may be on the skin. Extra protection is provided by treating clothing with permethrin or etofenprox, to prevent mosquitoes from biting through clothing. Label instructions should be followed to avoid damage to certain fabrics. In tick- and flea-infested areas, feet should be protected by appropriate footwear and by tucking long trousers into the socks. Such measures are further enhanced by application of repellents to the clothing.

Travellers camping in tents should use a combination of mosquito coils, repellents and screens. The mesh size of tent screens often exceeds 1.5 mm, so that special mosquito screens have to be deployed.

Screening of windows, doors and eaves reduces exposure to flying insects. Accommodation with these features should be sought where available.

Air-conditioning is a highly effective means of keeping mosquitoes and other insects out of a room. In air-conditioned hotels, other precautions are not necessary indoors.

Avoid contact with freshwater bodies such as lakes, irrigation ditches and slow-running streams in areas where schistosomiasis occurs.

Further reading

Bites and stings due to terrestrial and aquatic animals in Europe: <http://www.who.int/wer/pdf/2001/wer7638.pdf>

Foodborne disease: a focus on health education. Geneva, World Health Organization, 2000. (See annex for comprehensive information on 31 foodborne diseases caused by bacteria, viruses and parasites.)

Hackett PH, Roach RC. High-altitude illness. *New England Journal of Medicine*, 2001, 345: 107—114.

Preventing travellers' diarrhoea: how to make drinking-water safe: http://www.who.int/water_sanitation_health/hygiene/envsan/travel/en/index.html

Rozendaal J. *Vector control: methods for use by individuals and communities*. Geneva, World Health Organization, 1997.

Vectors of disease, Part I: <http://www.who.int/wer/pdf/2001/wer7625.pdf>

Vectors of disease, Part II: <http://www.who.int/wer/pdf/2001/wer7626.pdf>

WHO advice on sun protection: <http://www.who.int/uv/en>

WHO guide on safe food for travellers: <http://www.who.int/fsf/brochure/trvl1.htm>

WHO guidelines for safe recreational waters:

Volume 1: Coastal and fresh waters

http://www.who.int/water_sanitation_health/bathing/srwe1execsum/en/index3.html

Volume 2: Swimming pools and similar recreational-water environments

http://www.who.int/water_sanitation_health/bathing/bathing2/en/

Intestinal parasites: risks for travellers

Travellers, particularly those visiting tropical and subtropical countries, may be exposed to a number of intestinal parasitic helminth (worm) infections. The risk of acquiring intestinal parasites is associated with low standards of hygiene and sanitation, which permit contamination of soil, sand and foodstuffs with human or canine faeces. In general, the clinical effects are likely to become apparent some time after return from travel and the link with the travel destination may not be apparent, which in turn may delay the diagnosis or lead to misdiagnosis. The following are the main intestinal parasitic helminths to which travellers may be exposed.

n Hookworms. Human and canine hookworms, particularly *Necator* and *Ancylostoma* species, may be a risk for travellers, notably in places where beaches are polluted by human or canine faeces. Humans become infected by larval forms of the parasite which penetrate the skin. *A. caninum* produces a characteristic skin lesion, cutaneous larval migrans, which is readily treated by anthelmintics such as albendazole.

n Tapeworms. The tapeworm *Taenia saginata* is acquired by consumption of raw or undercooked beef from cattle that harbour the larval form of the parasite. *T. solium* is similarly acquired from raw or undercooked pork. These tapeworm infections result from access of cattle and pigs to human faeces, from which they ingest tapeworm eggs. *T. solium* infection in humans may also result from ingestion of *T. solium* eggs in food contaminated by faeces; this is particularly dangerous, since the larval forms of the parasite cause cysticercosis, which may produce serious disease. The tapeworm *Echinococcus granulosum* causes cystic hydatid disease due to infection by the larval form of the parasite; the adult tapeworms infect dogs, which excrete eggs in the faeces. Human infection is acquired by ingestion of eggs following close contact with infected dogs or consumption of food or water contaminated by their faeces.

n Roundworms. The intestinal roundworm (nematode) parasites *Ascaris* and *Trichuris* are transmitted in soil. Soil containing eggs of these parasites may contaminate foods such as fruit and vegetables, leading to infection if the food is consumed without thorough washing; infection may also be transmitted by the hands following handling of soil-contaminated foods, for instance in street markets.

Table 3.1 **Principal disease vectors and the diseases they transmit^a**

Vectors	Main diseases transmitted
Aquatic snails	Schistosomiasis (bilharziasis)
Blackflies	River blindness (onchocerciasis)
Fleas	Plague (transmitted by fleas from rats to humans)
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Mosquitoes	
<i>Aedes</i>	Dengue fever Rift Valley fever Yellow fever
<i>Anopheles</i>	Chikungunya Lymphatic filariasis Malaria
<i>Culex</i>	Japanese encephalitis Lymphatic filariasis West Nile fever
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Sandflies	Leishmaniasis Sandfly fever (<i>Phlebotomus</i> fever)
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Ticks	Crimean–Congo haemorrhagic fever Lyme disease Relapsing fever (borreliosis) Rickettsial diseases including spotted fevers and Q fever Tick-borne encephalitis Tularaemia
Triatomine bugs	Chagas disease (American trypanosomiasis)
Tsetse flies	Sleeping sickness (African trypanosomiasis)

^a Based on extensive research, there is absolutely no evidence that HIV infection can be transmitted by insects.