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Recreational Infections

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KEY CONCEPTS

- Recreational activities, whilst being good for physical and psychological health, expose people to increased risks of infection and disease.
- Both air and sea travel are associated with outbreaks of infection – mainly gastrointestinal and respiratory – with potentially complex modes of transmission in a confined space.
- Hiking, trekking and other outdoor pursuits can expose people to vectors such as ticks and mosquitoes they might otherwise not encounter, and incidence of arboviral diseases such as West Nile virus and tick-borne encephalitis is increasing.
- Recreational activities such as swimming in both seawater and swimming pools are associated with gastrointestinal illness from bacteria such as coliforms, viruses such as norovirus and protozoa such as *Cryptosporidium*.
- Activities such as canoeing, fishing and use of whirlpool spas and jacuzzis all put people in contact with water that may be potential sources of infection.
- The risk of transmission of blood-borne viruses through contact sports is negligible, but outbreaks of hepatitis B transmission have occurred. There are no confirmed cases of HIV transmission through contact sports.
- Mass gatherings, such as music festivals and sports spectatorship, can lead to outbreaks of respiratory infection such as influenza and gastrointestinal illness due to overcrowding at venues, lack of amenities, problems with food handling and mixing of infectious and susceptible populations.

TABLE 71-1 Recreational Activity Associated with Infection

Activity	Risk
Travel (especially 'adventure travel')	Infection during travel (gastrointestinal and respiratory pathogens) Geographic (tropical) infection
Animal contact: keeping pets, zoo/farm visits, etc.	Zoonotic infection
Outdoor activities: camping, trekking, barbeques, etc.	Zoonoses acquired by ingestion, inoculation, inhalation and arthropod transmission
Water contact: bathing, jacuzzi, canoeing, sailing, etc.	Ingestion, inoculation and inhalation
Contact sports: rugby, wrestling, football, etc.	Skin infection, blood-borne viruses
Vigorous exercise	Possibly respiratory infection

Introduction

In the second decade of the 21st century, whilst we still eagerly await the arrival of the predicted age of leisure, many people spend their out of work hours in more adventurous and imaginative ways. This chapter examines how these activities expose them to increased risks of infection and disease. Along with many other factors that predispose to clinical infection, recreational behavior may either expose the host to infective organisms or modify the immune response, thereby increasing susceptibility to infection and disease. Recreational infection can be classified by recreational activity or according to the particular infections (or systems infected, see Table 71-1). Inevitably there is considerable overlap with other sections of this book, such as international medicine (see Section 6) and zoonotic infection.

Travel

Travel is a common recreational activity either as an end in itself or in order to participate in other recreations. Travelers may be exposed to infection either during the journey or at their destination. During travel, there may be exposure to gastrointestinal pathogens in mass-produced food or exposure to respiratory pathogens from air-conditioning units and fellow travelers. In addition, the general fatigue of long-distance travel may perhaps lower resistance to infection in a nonspecific manner.[1]

Outbreaks of food poisoning from airline food occur infrequently in the modern era but are well described.[2] Responsible pathogens are most frequently *Salmonella* and *Staphylococcus aureus*; however, even cholera has been transmitted in this way.[3] Respiratory infection, including influenza A, H1N1, severe acute respiratory syndrome (SARS) and multidrug-resistant pulmonary tuberculosis, have also been transmitted during aircraft flights.[4,5]

An estimated 13 million passengers around the globe travel on cruise ships each year. Cruise ships can be responsible for respiratory and gastrointestinal infections, involving complex patterns of transmission in a closed community.[6] Modes of transmission include person-to-person spread, water-borne, food-borne, airborne, vector-borne and even shore excursions. Historically, a number of bacterial infections including cholera and typhoid have been associated with ship-borne spread. The pathogens most commonly implicated nowadays are norovirus,[7,8] *Legionella*, *Salmonella*, *Escherichia coli*, *Vibrio* and influenza A and B.[6]

There is a well-recognized association between outbreaks of *Legionella* infection and air-conditioning systems in holiday hotels.[9] Western travelers increasingly seek more exotic destinations where, as a result of poverty and poor infrastructure, they may be at risk of infection with common pathogens (particularly of the gastrointestinal and respiratory tracts). They may also be at risk of tropical infections that do not exist in their own country (e.g. malaria). These risks are discussed in detail in Section 6.

Zoonoses

Zoonoses are infections of animals which can be transmitted to humans. Many leisure activities increase the opportunity for contact between humans and animals, with consequent increased risk of infection. Keeping pet animals is a common recreational pastime and increases risks of zoonotic infection. The UK recently had an outbreak of *Hantavirus* amongst owners of pet rats.[10]

Hiking, camping and caving increase the risk of zoonoses. People may hike in a temperate climate or, increasingly, may choose to trek in a tropical or developing country. These activities increase the potential

for contact with infected animals. Infection can then be transmitted by a number of possible routes, such as:

- inhalation (e.g. Q fever, anthrax);
- ingestion of contaminated food or water (e.g. *Salmonella*, *Brucella*, *Toxoplasma*);
- animal bites (e.g. rabies, skin infections);
- exposure of skin to contaminated water (e.g. leptospirosis, schistosomiasis, mycobacteria);
- exposure of skin to sand (e.g. strongyloides, cutaneous larva migrans and jigger flea); and
- via arthropod vectors (e.g. arboviruses, Lyme disease).

ZOONOTIC INFECTION ACQUIRED BY INHALATION

Inhaled zoonoses that can be acquired by the intrepid outdoor explorer include Q fever (caused by *Coxiella burnetii*) and brucellosis (more commonly acquired by ingestion). Rarer problems include plague, anthrax, tularemia and psittacosis.[11]

ZOONOTIC INFECTION ACQUIRED BY INGESTION

There are certain recreational activities that particularly expose participants to increased risks of ingesting pathogenic organisms (which are often zoonotic, although they may be exclusively human parasites). Backpackers drinking inadequately boiled or purified water may become infected with *Cryptosporidium* spp., *Giardia* spp., hepatitis A, *Aeromonas* spp. and *Salmonella* spp. Barbecues are particularly notorious for inadequately cooked meat or fish and consequent infection with *Salmonella* spp.,[12] *Campylobacter* spp.,[13] *Staphylococcus aureus*,[14] and other more exotic organisms such as *Trichinella* spp.[15] There have been well-documented outbreaks of cryptosporidial infection in children enjoying recreational visits to farm open days.[16,17]

ARTHROPOD-BORNE ZOONOSES

Viruses that must spend some of their life cycle in a blood-sucking arthropod are known as arboviruses. Over 200 such viruses have been identified and over 70 have been reported as affecting humans. In 2012, 5780 cases of presumed or confirmed arboviral disease were reported in the USA, of which the majority was West Nile virus with 5674 cases.[18] West Nile virus, spread by mosquitoes, is now seen throughout the USA and Southern Europe and outdoor activities such as camping and hiking put people at increased risk of bites by these arthropod vectors. Yellow fever is a life-threatening mosquito-borne, zoonotic viral infection and the illness remains a risk for travelers and residents during outdoor activities in endemic regions of Africa and South America. In certain parts of Europe, tick-borne encephalitis (TBE) is regularly reported and a major risk factor is outdoor recreation (in particular, walking through long grass while wearing short trousers). The increased incidence TBE in recent years is thought to be due in part to increased time spent outdoors due to the warm weather.[19] An inactivated vaccine is available.

Tick-borne rickettsiae (see Chapter 187) are also potential pathogens amongst those who enjoy the outdoors.[20] They are mainly of the spotted fever group. In southern Europe, Africa and India, the disease is called tick typhus or boutonneuse fever and is caused by *Rickettsia conorii*. In the USA, it is Rocky Mountain spotted fever, caused by *Rickettsia rickettsii*. New rickettsioses identified during the past decade include Japanese spotted fever, Astrakhan fever, Flinders Island spotted fever, California flea typhus, African tick-bite fever and *R. slovaca* infections in central France.

Scrub typhus may affect the trekker in eastern Asia. The infective organism is *Orientia tsutsugamushi*. The reservoir is rodents and the vector is the larva (chigger) of the trombiculid mite. Clinically the disease resembles other rickettsial infections, and prevention and treatment strategies are similar.

Lyme disease (see Chapter 46), caused by infection with *Borrelia burgdorferi*, may also be acquired by recreational exposure, especially in the northern hemisphere.[21] The reservoir consists of mammals such as rodents and deer, with infection being spread by hard ticks (the *Ixodes ricinus* complex).

Infections Caused by Exposure to Water

A large number of infections can be caused by exposure to water (Table 71-2), and some of these have already been discussed in the section on zoonoses. Exposure to water can take place in a variety of recreational contexts: trekkers and fishermen may wade through infected water, people may bathe in fresh water or seawater, and people may undertake other nonbathing recreational activities in water (e.g. water skiing, sailing, canoeing). There is also an increasing popularity of spa baths, whirlpool baths and jacuzzis.

As with arthropod-borne infections, infections related to water may be acquired by a number of routes, including ingestion, aspiration, inhalation of aerosols, and penetration of skin or mucous membranes by invasive organisms. A variety of clinical infections, including gastrointestinal infection, hepatitis, conjunctivitis, pneumonia, skin and soft-tissue infection, may result, and numerous diverse organisms have been implicated.

Pathogenic organisms may enter the water from exogenous sources such as human contamination (e.g. sewage), animal and bird contamination, and farm effluent. Organisms may also come directly from aquatic animals or protozoa or be free living in the water supply.

INFECTION ASSOCIATED WITH WHIRLPOOLS

Jacuzzis, whirlpool baths and spa baths, which are increasingly found in leisure resorts, have the potential for the transmission of cutaneous, mucosal and respiratory infection. The main pathogens implicated in these infections are *Pseudomonas aeruginosa* and *Legionella pneumophila*. *Pseudomonas* folliculitis and infection of wounds, eyes, ears and urinary tract in association with whirlpools can all occur.[22] Fatal

TABLE 71-2 Infections Spread via Recreational Contact with Water

Mode of Spread	Bacteria	Virus	Protozoa	Helminths
Fecal–oral spread (accidental ingestion)	*Escherichia coli* *Salmonella* spp. *Vibrio* spp. *Aeromonas* spp. *Shigella* spp.	Enteroviruses (including polio) Hepatitis A Norovirus	*Cryptosporidia* *Giardia* spp.	
Direct inoculation	*Leptospira* *Mycobacterium marinum* *Pseudomonas* spp. *Vibrio* spp. *Aeromonas* spp.		*Naegleria* *Acanthamoeba*	*Schistosoma*
Aerosol or aspiration	*Legionella* spp. *Pseudomonas*	Adenoviruses		

Pseudomonas pneumonia in an immunocompetent female with jacuzzi exposure has been described.[23] One study in Northern Ireland sampled 51 jacuzzis and found over 70% were positive for *P. aeruginosa*.[24]

Legionella spp. (mainly *L. pneumophila*, but other species are also implicated) cause two distinct syndromes:

- Legionnaires' disease (or Legionnaires' pneumonia), which is usually a severe pneumonic illness requiring appropriate antibiotic treatment; and
- Pontiac fever, which is generally a more benign self-limiting illness causing myalgia, fever and headache.

The latter syndrome has frequently been associated with whirlpool use, although outbreaks of Legionnaire's disease associated with whirlpool spas have also been described.[25]

INFECTION FROM BATHING

Numerous case reports and reviews have associated bathing in swimming pools, natural fresh water and the sea with gastrointestinal, respiratory and cutaneous infection. In swimming pools there have been reports of infection with *Shigella*, *Giardia* and *Cryptosporidium* spp. and various viruses including hepatitis A virus and coxsackievirus, and an increasing incidence of outbreaks due to norovirus, although this may be due to increased testing.[26]

The association of sea bathing and disease is a major political issue as millions of dollars are spent in the industrialized world in an effort to improve sewage disposal and enhance the quality of bathing water. Microbiologic standards now exist for bathing water in Europe and North America. There is certainly a risk of infection from swimming in heavily contaminated water but the risk of minor symptomatic infection from swimming in less heavily polluted water remains contentious.[27] A cohort study of swimmers in public beaches in Spain found incidence rates of gastrointestinal, cutaneous and high respiratory tract symptoms were higher in bathers, but the differences were not statistically significant. Symptoms were related to the number of total coliforms and fecal coliforms in the water.[28]

INFECTION IN NONSWIMMING RECREATIONAL WATER ACTIVITIES

Many people are exposed to infection by recreational use of water in activities such as angling, canoeing, water skiing, sailing and white water rafting.

Leptospirosis (see Chapter 130) is traditionally regarded as a significant risk. It is estimated that on average in the UK there are 5 million recreational water users each year exclusive of bathers, and yet amongst this at-risk population there are only 2.5 cases of leptospirosis a year.[29] The annual total incidence of leptospirosis in England and Wales is more than 10 times that figure; it occurs principally among agricultural workers. Leptospirosis is a zoonotic infection that is mainly carried by rodents; it is estimated that about 25% of the rats in UK are infected. The risk of contracting infection relates less to the overall water quality than to the density of the local rodent population. Triathlon and other forms of 'adventure racing' have led to outbreaks of leptospirosis.[30] Sejvar *et al.* described the outbreak that occurred during the 2000 'Eco-Challenge' event in Sabah, Borneo.[31] Of 304 competing athletes, 42% met the case definition for leptospirosis. The authors suggest that taking 200 mg of doxycycline weekly during exposure may limit infection and disease (a strategy previously demonstrated to be effective by the US military).

So-called adventure sports can also be associated with gastrointestinal infection. One of the largest reported *Campylobacter* outbreaks in Canada occurred in June 2007 in British Columbia, associated with a mountain bike race that took place in muddy conditions.[32] Of 537 racers included in a retrospective cohort study, 225 racers (42%) reported diarrheal illness after the race. *C. jejuni* clinical isolates were found to be identical by multi-locus sequence typing.

MISCELLANEOUS WATER-RELATED INFECTIONS

Naegleria and *Acanthamoeba* spp. are free-living amebae with no insect vector or human carrier state. They have been isolated on a worldwide basis from water and soil, and rarely can produce a severe amebic meningoencephalitis that is usually fatal (see Chapter 193).[33]

Schistosomiasis is dealt with in detail in Chapter 118. The cercariae of human schistosomes penetrate intact human skin and then migrate to their favored site to commence their maturation. Within 24 hours the penetration of the skin can produce a pruritic papular rash that is called 'swimmers' itch'. Avian schistosomes are found in temperate climates, including in the Great Lakes of North America, and although they are unable to mature past the cercarial stage in a human host and therefore cannot give rise to later stage schistosomiasis, they can be responsible for producing a significant 'swimmers' itch'. *Schistosoma mansoni*, and *S. haematobium* are particularly recognized in swimmers who have bathed in Lake Malawi and the other rivers and lakes of East Africa.

Infection Spread by Direct Contact

Many sports such as boxing, judo, and rugby, require close physical contact on the sports field and may also involve close contact in the changing rooms with shared towels, shaving equipment, etc. The close contact in the scrum of rugby football may transmit herpes simplex virus and cause a condition called scrumpox or herpes gladiatorum. This is highly infectious and may spread rapidly between players. Aciclovir is effective treatment. Staphylococcal infection (including methicillin-resistant *Staphylococcus aureus* (MRSA)) may also be spread in similar circumstances and there have been a number of MRSA outbreaks in American football National Football League (NFL) players in recent years that have attracted media attention.[34] The moist atmosphere of changing rooms may promote the transmission of cutaneous infections such as verrucas, athlete's foot (*Tinea pedis*) and Dhobie itch (*Tinea cruris*).

Tetanus is caused by contamination of a wound by the spores of *Clostridium tetani*. After contamination, the organism then elaborates a toxin that produces the clinical syndrome of tetanus. Although immunization against tetanus is widely practiced, there is still a risk to those playing contact sports (especially rugby and football), as well as to those pursuing more leisurely activities such as gardening.

Gardening is usually considered a fairly safe pastime, but tetanus is a potential risk, and sporotrichosis (see Chapter 190) can be acquired by scratches from rose thorns and similar injuries. In addition, pregnant women who garden are at risk of toxoplasmosis infection through cat feces, with catastrophic consequences to the fetus if congenital infection occurs, and therefore should be advised to use gloves when gardening to avoid the possibility of infection.[35]

BLOOD-BORNE INFECTION TRANSMISSION IN CONTACT SPORT

The risk of transmission of blood-borne pathogens during contact sport is thought to be extremely low and numerous guidelines exist to limit the risk still further. In rugby football, for example, a player with an open or bleeding wound must leave the field until the wound is covered and the bleeding controlled.[36] There were large outbreaks involving hundreds of cases of hepatitis amongst orienteers in Sweden from 1956 to 1966, and on the basis of the clinical and epidemiologic picture these were assumed to be due to hepatitis B virus (HBV), although a serologic test was not available.[37] Several modes of transmission were postulated, including twigs contaminated with infected blood inoculating subsequent competitors, contaminated water in stagnant pools and transmission during washing after competition. It was established that 95% of orienteers received scratches or wounds during the competition. More recently, there have been reports of outbreaks of HBV infection among sumo wrestlers in Japan[38] and NFL American football players.[39] There are no confirmed documented cases of HIV transmission during sports.

MASS GATHERINGS

Sports spectatorship, music festivals and other mass gatherings are also associated with transmission of infection, most commonly

gastrointestinal and respiratory. Overcrowding at venues, lack of amenities, problems with food handling and mixing of infectious and susceptible populations have all been cited as being contributing factors.[40] Outbreaks of influenza were reported at the Winter Olympics at Salt Lake City, USA in 2002 and a mumps outbreak at a youth festival in Austria; large outbreaks of *Shigella* and *Campylobacter* have been reported from music festivals. Suggestions of increased sexually transmitted infections (STIs) at these recreational events is difficult to prove and has not been backed by evidence. For example, a study looking at the Rugby World Cup in 2011 in New Zealand found high consumption of alcohol and low condom use amongst people at sexual health clinics reporting Rugby World Cup related sex, but no increase in attendance at sexual health clinics or STI diagnoses.[41]

Conclusion

Recreational activities can expose participants to novel infectious agents that they are less likely to encounter in other contexts. In many of these the diagnosis may not be very obvious unless the condition is considered. Physicians need to add 'recreational history' to the already extensive list of travel, occupational and animal exposure details about which they need to enquire when evaluating a patient with a suspected infection.

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