Expedition medicine

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An expedition has been defined as an organised journey or voyage for a specific purpose, especially for exploration or for a scientific or military purpose.

Expeditions often take place in conditions that are demanding in terms of climate, terrain and the nature of the activities undertaken. They may involve a wide variety of health risks and other objective dangers. Their physically demanding nature and the remote and unfamiliar surroundings experienced may also make great psychological demands on their participants.

Medical care on expeditions demands a high degree of planning and organisation, and a structured approach is necessary. Planning the medical care of an expedition will bring together many of the elements of travel medicine

Pre-expedition planning

The key elements of planning expedition medical care could be described as the who, what, where, when, how and why of the expedition:

Who will take part in the expedition? The age, current health status, physical and mental fitness vaccination status and current medication, if any, must all be taken into account during planning.

Where will the expedition go? The destination country or countries and the specific areas of those countries must be known and the potential health hazards particular to those areas investigated.

When will the expedition go? The departure time must be known in order to organise pre-travel health care such as vaccination schedules. The time of year may also influence specific disease risks on arrival.

How will the expedition travel? Modes of travel to the destination and within the destination country may carry their own specific risks to life and health which must be taken into account during planning.

Why is the expedition going? The activities involved in the expedition may involve increased risk of hazards from climate, altitude, close personal contact, contact with hazardous animals or plants and so on. In addition the motives of individual members for joining the expedition and their personal psychological “baggage” may be a potential source of problems.

What precautions are needed and what equipment will be needed? A pre-travel questionnaire and possibly a pre-travel health check or information from each member’s doctor (with written permission) will help to answer some of the initial questions raised above. Vaccination schedules and malaria prophylaxis, where appropriate, will need to be planned and a pre-travel health briefing arranged for the whole team. The contents of the medical kit will need to be planned, based on such factors as a

health risk assessment for the destination and activities to be undertaken, the level of experience and expertise of the expedition doctor, nurse or medic, the overall philosophy and approach of the expedition to risks and their management and its carrying capacity for medical equipment.

These planning elements will each be considered in a little more detail.

Who? The expedition members

A medical questionnaire should be circulated to all expedition members. The information to be gathered will depend to some extent on the nature of the expedition, but some necessary information will be common to all. Current vaccination status and adverse reactions to vaccines or antimalarial drugs in the past should be included, as should susceptibility to chronic or recurrent medical conditions and current medication. If medication is being taken, individuals should be advised to obtain enough supplies to last through the expedition, with some to spare in case of loss. Food or other allergies should be documented. If the proposed activities of the expedition pose potential health hazards, questions should be asked about any previous problems associated with these hazards. For example, it is particularly important to know about previous experience of frostbite and complications of high altitude, as there may be a recurrence of these problems on subsequent exposure to similar conditions. The presence of musculoskeletal problems of otherwise relatively minor importance may be of great significance for expeditions that involve a great deal of physical exertion.

A pre-travel medical briefing may be appropriate for many expedition members. The members of different types of expedition may vary widely, from schoolchildren on their first trip abroad to experienced and well-travelled explorers, mountaineers, canoeists or cavers. Those with a great deal of experience may be very well informed about the hazards of their chosen itinerary and activities, but this cannot be assumed.

The activities undertaken by some other expedition members may not correspond with their level of experience: for example, people with little experience of high altitude may hire professional guides and travel into the world's highest mountain ranges, perhaps even to Everest. The pre-travel briefing must therefore be carefully tailored to the level of knowledge and experience of the expedition members. It should include information on the degree of risk from health hazards peculiar to the country being visited, explanation of the risks inherent in their chosen activities and how these risks may be avoided or minimised.

Expedition travellers, like other travellers, should obtain adequate ***insurance*** which covers pre-existing medical conditions, medical and rescue expenses and medical repatriation in case of illness or trauma. The usual sources of travel insurance may not offer cover for expedition members, especially where hazardous activities are involved. The British Mountaineering Council (BMC) offer expedition insurance (www.thebmc.co.uk) and in the commercial sector Aon (www.aon.com) are also able to arrange various types of group insurance.

Where? The expedition's destination

The expedition doctor will need to be aware of precisely which parts of a country will be visited and of the health hazards that exist in them. The assessment of risk is addressed in Unit 2a, but it will be necessary to consult a comprehensive, up-to-date database to check on the hazards likely to be

encountered, unless the expedition doctor is already reliably acquainted with the destination. For example, countries in which there is a low risk of malaria for tourists may have a much greater risk for those on expeditions travelling into rural areas; countries that carry a high risk of malaria in lowland regions are likely to have little or no such risk in their highland or mountain regions.

Travel to remote areas of a country poses particular problems which will be examined in more detail later, and which may need a considerable amount of forward planning. For example, though the risk of rabies for travellers is extremely small, it is invariably fatal and expeditions may be far distant from access to post-exposure rabies vaccination. Also, in more remote areas medical facilities, e.g. for trauma, may not be of as high a standard as they are in major cities. The expedition doctor is therefore likely to advise rabies and hepatitis B vaccination. Planning for independence from medical facilities may be essential. Even if available, they may not be of an acceptable standard. A plan for medical evacuation will also need to be considered.

When? The timing of the expedition

The time of year in which an expedition is planned to take place may influence the degree of risk of some of the inherent health and safety hazards. River crossings may be more difficult and hazardous in the ***rainy season*** and contamination of drinking water may be increased if faecal material is washed into the source of supply by heavy rainfall. Expedition members may be at greater risk of Japanese B encephalitis if they visit southeast Asia in the wet season, particularly if their stay is to be prolonged. There may be an increased risk of meningococcal infection in the ***dry season*** in, for instance, sub-Saharan Africa, particularly if expedition members are likely to be living in close contact with indigenous people during their stay. In addition the risk of most of the health hazards, especially infectious and insect-borne diseases, will be increased by the length of the expedition.

The length of time available before departure is important in planning medical care, especially when multi-dose vaccination schedules are involved, and it is important for the provider of medical care to an expedition to be recruited early in the planning stages.

How? The expedition's mode(s) of travel

Many expedition travellers will use ***air transport*** to reach their starting point. Being usually fit and healthy, this will not normally pose a risk, but conventional advice about limiting alcohol, avoiding dehydration and avoiding prolonged immobility during long flights may need to be emphasised. ***Overland travellers*** face a different range of risks, including injury in a road traffic accident, and they will need to consider how they will plan for dealing with the effects of major or minor trauma and casualty evacuation. Other hazards of overland travel, depending often on whether public transport is used, may include close proximity with fellow travellers and their droplet infections, fleas and lice from animals or fellow-travellers, food and water hygiene, dust and other irritants, allergens and poor or non-existent sanitation.

Why? The expedition's activities

Many expeditions aim to expand personal frontiers by satisfying their participants' need for adventure through doing something that has not been done before or that they personally have not done before. Others are undertaken to expand the frontiers of human knowledge by exploring a remote area or by

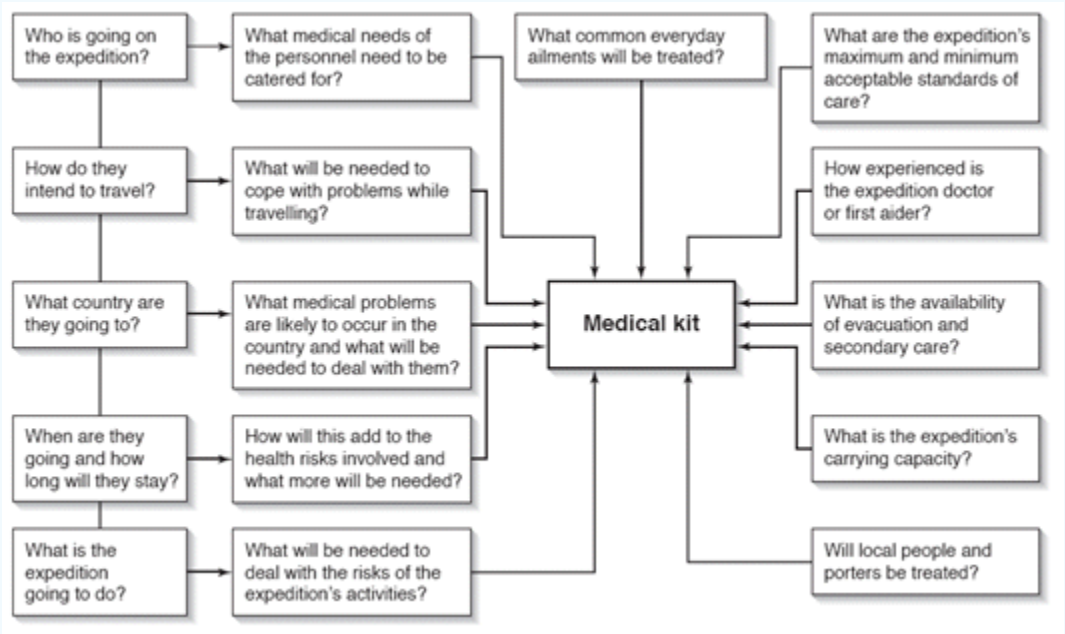
carrying out research into the environment, anthropology, archaeology or other subjects. Their activities are therefore so diverse, it would be impossible to detail all of the hazards each of them poses.

Expeditions on or in ***water*** involve risk of drowning, hypothermia and water-borne diseases such as faecal-oral infection, schistosomiasis and leptospirosis. These potential problems will need to be taken into account in the planning of medical care. Expeditions with other objectives may travel into a wide range of high-risk environments, some of which we'll look at in more detail later. Some expeditions may have ***cultural*** objectives and participants on these, and indeed participants on all expeditions, would be well advised to learn as much as possible about the culture they will encounter at their destination. In doing so, they will profit more from their experience and avoid offending the cultural sensitivities of their hosts. This will also help to make them aware of some of the potential health hazards to which local cultural demands may expose them.

What? The expedition medical kit

Many factors will influence the decisions on what to include in the expedition's medical kit. The level of ***experience*** of the expedition doctor, nurse or medic will determine to some extent the level of care that can be provided, but even the most experienced person will still not be able to provide the level of care available in a UK medical facility. There is little to be gained by having complex equipment available, e.g. for resuscitation or intravenous fluid therapy, if subsequent necessary stages of management are not available, though on some occasions short term fluid replacement may be possible by using rectal administration of fluids made up from salt and water. The ***philosophy*** of the expedition on risk management will also determine the level of care provided, and acceptable levels of care for illness and trauma must be the subject of a team discussion early in the planning stages. The quality and availability of ***local medical facilities*** such as primary and secondary medical care at the destination are likely to influence the level of care to be provided for the team and therefore the contents of the medical kit, and these facilities should be investigated when planning medical care. The availability of ***evacuation*** and**/**or ***repatriation*** of sick or injured expedition members is also likely to influence the level of equipment needed. In addition to medical supplies needed for hazards specific to the conditions of the expedition, treatment of everyday ***minor illness*** or complications of any ***pre-existing health problems*** such as asthma, diabetes or epilepsy needs to be considered when planning the medical kit. Another factor influencing what can be included in the medical kit is the expedition ***logistics***. All expedition equipment has to be transported to the destination country and from its point of arrival in the country to where it will be needed. The expedition's budget and carrying capacity will therefore need to be taken into account in the planning process. Figure 1 illustrates how all these variables feed into planning the contents of an expedition medical kit.

Planning the contents of a medical kit



Treatment of local people at the destination

Guides and porters employed by an expedition should be offered medical care for illness and trauma occurring during the expedition. Care must be taken about treating chronic medical problems, as the treating doctor may not be able to follow the progress of the condition to a conclusion and it may not be possible for treatment to be continued after he or she has left the country. Vigilance and careful explanation in the appropriate language are necessary, as those with a less sophisticated concept of disease and treatment may pass on medication inappropriately to others for treatment of a completely different type of problem. For example, the author discovered on one occasion that an antibacterial

drug that he had given appropriately to a porter had been so effective in the patient's eyes that he had passed it on to another porter to treat his high altitude headache!

Except in an genuine emergency it is probably better not to treat other local people. They may well be given false expectations of what can be achieved by such treatment, and when the expedition has moved on they will be thrown back upon the resources of whatever local services are available without the ability to monitor or continue the treatment given by the well-meaning expedition doctor, either by lack of availability of the treatment, lack of understanding of its use or lack of the financial means of obtaining further supplies.

Environmental hazards of expeditions

Hot climates

Heat loss from the body in temperate climates takes place through all available routes − radiation, convection and conduction, as well as by evaporation of sweat.

In hot climates, the ambient temperature may approach or even exceed body temperature, and the only available method of cooling in extreme conditions is by evaporation of sweat. If the environment also has high humidity, as, for example, in jungle regions, evaporation is greatly reduced, adding to the difficulty in maintaining body temperature. Exertion further increases the loss of water from sweating.

Dehydration. A high intake of water, which may amount to several litres per day, is needed in hot climates. Additional salt on food is advisable, at least until acclimatisation to the conditions is achieved. Water should be taken in excess of what appears to be necessary from the sensation of thirst. The adequacy of hydration can be assessed by the output of pale coloured urine. Acclimatisation takes place within about two or three weeks of arrival in a hot climate and involves an increased ability of the body to conserve salt and water while still retaining the ability to cool itself by sweating. ***Clinical signs*** of dehydration e.g. loss of skin turgor may not be evident until at least 10% of body water has been lost. Death is likely when 20% has been lost. Earlier ***symptoms*** are a strong sensation of thirst (1% loss) and drying up of the saliva in the mouth (5% loss). Headaches, nausea, fatigue and confusion may follow.

Heat exhaustion is the result of excessive loss of salt and water from sweating and/or inadequate salt and water intake. Its ***symptoms*** include feelings of weakness and exhaustion and may lead to hypotension, faintness and collapse. There may be a sensation of extreme thirst and urine output is reduced. There may also be muscle cramps if there is substantial loss of salt. The body temperature is normal. Heat exhaustion may be avoided by an adequate intake of fluid and by adding additional salt to food. If this is done, salt tablets are seldom needed. ***Treatment*** consists of rehydration with oral fluid made up, as for the treatment of diarrhoea, by giving copious drinks, each glass containing a small pinch of salt, or by making up drinks with one teaspoonful of salt per litre.

Heat hyperpyrexia occurs when the cooling mechanism of sweating breaks down and the body temperature rises unchecked. ***Symptoms*** include headache, flushing and confusion which may lead to drowsiness, delirium and coma, and convulsions may ensue. The subject's skin feels hot and dry. **Treatment:** rapid cooling by any means available is essential, as the condition is life threatening. Removal from direct sources of heat such as strong sunlight, immersion in cool water if available,

covering with lightweight wet fabric or repeated sponging with cool water and exposure to a draught of air or a current from a fan are all useful in reducing the temperature.

Prickly heat is seen as a rash consisting of minute papules or vesicles with an intense prickling sensation. It appears to be caused by excessive sweating and obstruction of the outflow from the ducts of sweat glands. Good hygiene and frequent changes of sweat-soaked clothing may reduce the likelihood of its occurrence. There is no specific treatment, but careful washing and drying of the skin and wearing loose-fitting clothing made from cotton, together with symptomatic treatment with an antipruritic such as calamine lotion, will help to relieve symptoms.

Sunburn is frequently a problem in hot climates. Expedition members may need to be reminded about the dangers of exposure to ultraviolet light and to cover exposed skin and use an effective sunscreen cream. Apart from the short-term effects of sunburn and the long-term effects of skin malignancy, exposure to ultraviolet light may also predispose susceptible individuals to herpes simplex infection of exposed skin. Exposure of the skin surface in hot climates also predisposes to insect bites and the resulting risk of insect-borne diseases. If insect repellents are being used, it is important that they are applied after the sunscreen cream – otherwise, they are likely to be ineffective.

Cold climates

Cold conditions are encountered at extremes of northern and southern latitudes and at high altitude. But what may be overlooked in planning an expedition is that in some circumstances, such as in deserts and at moderately high altitudes, daytime temperatures may be high, but night temperatures may be very low. Inadequate food intake and wet or inadequate clothing and sleeping bags predispose to cold-related illness. Those who are ill or injured are also more prone to both hypothermia and cold injury. It is important when travelling in conditions in which the air temperature may fluctuate suddenly from warm to cold that expedition members are reminded to carry layers of additional insulating clothing, hats and gloves and to put them on as soon as the temperature begins to fall.

Hypothermia is said to occur when the body core temperature falls below 35°C Some mental processes, such as decision making, may already be impaired at this temperature, and excessive shivering may occur. Below this temperature, behaviour becomes inappropriate, clumsiness and confusion occur and, as the body temperature falls lower, there is impairment or loss of consciousness and the shivering stops. When the temperature has fallen to 30°C, it is difficult to detect vital signs such as pulse or respiration. Below 28°C, death is a likely sequel unless warming is begun immediately. The ***early signs*** of hypothermia may resemble those of altitude sickness or dehydration. It is important in cold conditions to operate a “buddy system” in which expedition members look out for such signs in each other.

It is not likely that sophisticated methods of ***re-warming*** will be available under expedition conditions. The victim should be insulated from further heat loss both above and below the body and sheltered from the cold environment as well as can be achieved. Sharing another person’s body heat in a sleeping bag and breathing air in a tent which is heated by the presence of others and by, for example, a cooking stove or heat-emitting lantern are the most practicable methods of rewarming.

Frostbite occurs when peripheral circulation is reduced in response to cold conditions and ice crystals form within cells causing tissue damage and, in severe cases, gangrene of the extremities. ***Appearance***: affected tissue has a pale appearance and a cold and dead feeling to the touch. ***Treatment***: affected areas may be ***rewarmed*** by immersion in water at or just above body temperature, but if a foot is affected and the victim needs to be evacuated on foot, it is better to allow walking on the frozen tissue before warming, as less damage will be sustained. Re-freezing and thawing must be avoided, as they cause further damage. There is no evidence to support the use of vasodilator drugs. As rewarming occurs, the tissues become red, swollen and very painful and blisters may form. Apparently dead tissue should not be treated radically in the field by debridement or amputation, as recovery may be greater than first appearances suggest. Decisions on radical treatment are best left to a surgeon experienced in the treatment of cold injury.

Frostnip is a less severe form of cold injury in which tissues do not undergo necrosis.

Jungles

The jungle environment is characterised by ***heat*** which is usually not as extreme as in some other hot environments (usually up to about 35°C) and high ***humidity***. The temperature does not fall to any great extent at night because of insulation by the tree canopy and cloud formation. Mosquitoes and other biting insects, leeches, snakes, animals and spiny or sharp-edged vegetation are among the natural hazards present in the jungle that an expedition may encounter. ***Clothing*** should cover as much of the body surface as possible to avoid damage from these hazards. ***Insect repellents*** are also needed.

Leeches find their way with apparent ease into clothing and footwear. Pulling them off may leave portions of them embedded in the skin, with resulting infection. If an alcoholic tincture of iodine is being carried for water purification, a drop or two placed on a leech makes it relax its grip; it may then be lifted off. Iodine may also be used to clean the site of the bite, which may easily become infected, but other skin antiseptics should be used for those with a history of iodine sensitivity. Salt, alcohol, tobacco or a lighted cigarette may also be applied to leeches tpo remove them.

Insect bites produce unpleasant allergic reactions in susceptible individuals. These may require the use of oral or topical antihistamines, though there is a small risk of skin sensitisation to topical antihistamine creams. Insect bites may become infected and topical or systemic antibiotic treatment may be needed. There is a risk of malaria transmission from mosquito bites in many jungle areas and dengue fever is a widespread and increasing hazard in many tropical and more temperate areas. Mosquito bites are a potential means of transmission of yellow fever in tropical areas of Africa and South America. It is important to remember that whilst malaria-transmitting mosquitoes bite between dusk and dawn those transmitting other infections bite during the daytime. Antimalarial drugs, where appropriate, and anti-mosquito precautions such as covering the skin, using insect repellents and sleeping under bed nets will reduce the risk of insect-borne diseases.

Snake bites. Not all snakes are venomous, and not all those that are venomous are life threatening. Snakes are best avoided and left undisturbed to go on their way. They will not usually strike at an immobile person or unless disturbed or attacked. If snakes are likely to be encountered, adequate footwear, such as boots, and protection of the legs by tucking trousers into socks are advisable. There is often little risk to life in the majority of snake bites, even from snakes known to be potentially harmful, as significant amounts of venom are not always injected. Calm reassurance and analgesics to relieve the pain of the bite may be the only treatment needed. The use of tourniquets to limit the spread of venom

from the bite can result in ischaemia and gangrene; it is usually better to apply firm bandaging and to immobilise a bitten limb by makeshift splinting. ***Clinical features:***If venom has been injected, there may be an entirely local reaction with pain and swelling. Depending on the species of the snake, other reactions may include hypotension and shock, haemorrhagic manifestations or neurotoxic effects such as paresis of muscles. The administration of ***antivenom*** should be restricted to those with more severe reactions, as its use may be associated with allergic or anaphylactic responses. Local knowledge of snakes, the effects of their bites and the need for antivenom should always be sought, ideally in advance, and envenomed patients should be taken to hospital if possible. It is often recommended that the snake should be killed and captured for identification, but this is often neither safe nor practical.

Other animals. Most animals are more likely to avoid humans than to attack them, but it would be dangerous to assume that this is always the case. Apart from the dangers of attack by a large animal, there is also the possibility of transmission of rabies to humans by bites or scratches, and possibly even licking, from a variety of mammals. If contact with animals is considered likely, or if the objectives of an expedition involve contact with animals, pre-exposure ***rabies vaccination*** should be advised, particularly if the expedition will be more than 24 hours away from a reliable source of post-exposure vaccination.

Fungal infections, especially of the feet are common in hot environments, particularly if they are also humid, and foot hygiene is very important. ***Wounds and insect bites*** also easily become infected and healing may be prolonged.

Deserts

Daytime temperatures may rise to very high levels in desert areas, but night temperatures may fall very low in the absence of tree or cloud cover. Warm clothing and sleeping bags are therefore necessary at night.

Ultraviolet radiation is at a high level during the day through direct radiation from the sun and by reflection from sandy or stony surfaces. Protection of the head by a wide-brimmed hat, light-coloured and loose-fitting clothing that covers as much as possible of the skin surface and application of a sunscreen will reduce the effects of exposure to the sun. Metallic “space blankets” may be used as a shelter from the sun, with the metallic layer outermost to reflect heat away.

Water supplies are scarce in desert environments, with long distances between them. A high fluid intake is needed in view of the high daytime temperature, and careful planning of water supplies is necessary when water resources are scarce.

A desert still, constructed from a sheet of transparent polythene weighted in the middle and stretched over a hole dug in the sand, enables condensate to be collected in a vessel placed in the centre of the hole to supplement water supplies.

High altitude expeditions

Problems specific to high altitude are addressed in another clinical topic posted on this website.

Expeditions to remote areas

Remoteness is not measured solely in geographical terms. The remote traveller is separated, whatever the distance involved, from home and family, friends, accustomed facilities, communications and medical help. Remote travel brings together all the strands of planning for the medical care of an expedition, including:

- What can the doctor deal with in the field?
- What equipment will be needed?
- Can the expedition carry all that might be needed?
- Will medical evacuation be possible?
- How will evacuation be organised?

Will secondary care be available? If so, of what quality, and how long will it take to reach it?

Psychological effects of remote travel. In addition to whatever physical hazards the expedition may involve, remote travel may carry psychological hazards for expedition members. Personality and psychological "baggage" are of great importance in the success of an individual's participation in an expedition. Those who join an expedition to escape from problems will almost inevitably bring those problems with them. Personality traits previously kept in check may come to the surface under the stress of remote expedition travel. It is advisable for expedition leaders or organisers to look carefully at what has prompted members to wish to join the expedition and at their personality and likely compatibility with other members. Friction with companions can be a significant problem. When expedition members are forced by circumstances to live in close contact for long periods, personality characteristics that may be perceived initially as charming eccentricities can change into causes of intolerable irritation. Personal space and possessions become jealously guarded and apparent inequalities of any kind are deeply resented. Fear of the environment may interfere with the individual's ability to play a full part in activities, particularly when the surroundings carry objective dangers. Fear of illness may lead to an almost paranoid suspicion of people, food and water. Fear of the unknown is common. Unfamiliar surroundings, food, customs and climate may produce an anxiety reaction. Anxiety about poverty, begging or theft may lead to extreme suspicion of the motives of local people encountered en route

Separation anxiety brought about through separation from friends and family may produce a reaction akin to the grief of bereavement

Food and water

Whatever the destination and activities of the expedition, the health risk most likely to be encountered is that of travellers' diarrhoea. ***Expedition food*** is often cooked in less than ideal circumstances. If a cook is employed locally, little is usually known about his or her personal hygiene or capacity for carriage of pathogenic organisms.

Water supplies for expeditions must be obtained from whatever sources are available locally, with all the attendant risks of contamination with pathogens.

Latrine arrangements under expedition conditions are often less than ideal and personal hygiene habits such as handwashing may be allowed to slip below customary standards. All of these circumstances conspire to produce ***faecal-oral infection***, which may be a greater threat to the success of an expedition than tropical diseases or objective hazards.

Some ground rules which would limit the likelihood of gastrointestinal infection may be laid down. ***Local cooks*** should be hired, when possible, from a reputable or previously known trekking agency. ***Latrines*** should be dug away from camp sites and sources of drinking water and downwind from the camp. A bowl of water reserved for ***hand washing*** and containing a dilute solution of potassium permanganate should be kept near the latrine and outside the mess tent. Cooks and expedition members should be encouraged to ***wash their hands after using the latrine*** and ***before preparing or eating food***. ***Fresh produce*** should be washed in a dilute solution of potassium permanganate or iodine and the consumer should peel fruit before eating. Food should be ***thoroughly cooked*** and eaten when still hot. ***Food storage*** should take into account the possibility of access by flying and other insects and by rodents. ***Drinking water*** should be boiled or purified chemically or by filtration.

Water purification

Boiling is a good method of destroying pathogens in water, but may be very demanding on scarce fuel supplies. There is evidence that simply bringing water to boiling point is adequate to destroy most pathogens and that prolonged boiling may not be necessary. Longer boiling may be needed at higher altitudes, where water boils at a lower temperature.

Filtration may be used simply to remove debris from water or to remove pathogens. Removal of debris by a fabric filter such as the Millbank bag produces water which needs further purification; the removal of solid matter nevertheless makes chemical purification easier to achieve. Ceramic filters remove most bacteria, amoeba, giardia and some (but not all) viruses. Other devices incorporate both filtration and exposure to an iodine resin compound and remove most pathogens, including viruses. Chemical contamination is not removed by filtration unless a carbon filter is also used. Recently introduced matrix filters such as the Seagull and First Need filters are claimed to remove 99.9% of viruses from water. The disadvantages of filtration devices include the slow speed with which they are able to produce a reasonable volume of drinking water and the limited life of the filtration unit, which needs to be cleaned or replaced.

Chemical purification involves the use of tablets that release chlorine, iodine in liquid or tablet form and silver salts that are present in some filtration devices. Iodine has a wider spectrum of action against viruses and encysted forms of amoeba than does chlorine. Four drops of 2% tincture of iodine should be added per litre of water and the solution should be left for 20 minutes at room temperature (longer in cold surroundings) before it is drunk. A plastic dropper bottle, such as is used for eye drops, makes an ideal container for the iodine. The addition of sodium thiosulphate, ascorbic acid or lemon juice after the purification period eliminates the taste of iodine.

Alternatively, a saturated solution of iodine may be prepared by putting iodine crystals into a bottle or jar, adding water and shaking. Ten millilitres of this solution added to a litre of water and left for 20 minutes will produce drinkable water. The iodine bottle is kept “topped up” from whatever source of water is available. Iodine is, of course, not suitable for those who are allergic to it, pregnant women or people with thyroid disease.

Expedition sanitation

Latrines at base camps should ideally be “long drop” if there is enough depth of earth to allow a pit to be dug to a depth of two or three metres (). Otherwise, the site should be changed regularly (avoiding previously used sites) before it is full. They should be downstream from sources of drinking and washing water and downwind from the camp. Earth should be kicked or shovelled into the pit after each use. A flammable liquid such as kerosene may be poured into the pit and carefully ignited from time to time. Latrines may also be dug in snow when camping above the snow line. Here, snow may be kicked into the pit after each use, but this will not be possible when temperatures fall below freezing. They should be situated downstream from daytime meltwater sources used for drinking or washing and away from sources of snow used for melting to provide water supplies. Ideally, toilet paper should be burned, particularly after casual wayside halts for defecation. The use of toilet paper is controversial and is offensive in some cultures in which the left hand is used for cleansing and is subsequently washed. There is no evidence that using paper is more hygienic or is associated with a lower risk of faecal-oral infection.

Medical emergencies

It has already been pointed out that expedition members cannot expect to have every conceivable medical and surgical emergency dealt with in the same way as it would be at home. The expedition doctor must also realise that it is not possible to allow for every eventuality. Medical emergencies may be caused by many conditions including asthma, epilepsy, myocardial infarction and diabetes.

Asthma attacks

Asthma attacks should be dealt with by giving oral corticosteroids (such as prednisolone 40 mg stat and daily) until the status quo is regained, plus multiple doses (10-12 initially and up to 25 or more) of a beta-agonist inhaler through a large volume spacer (which may be improvised using a plastic bottle or a rolled-up sheet of paper). The expedition doctor should have been alerted to the possibility by prior knowledge of the condition.

Other respiratory problems

Pneumonia with pleurisy and ***pulmonary embolus*** may both occur at high altitude and may be difficult to distinguish at first sight. Clinical signs, pyrexia and systemic disturbance will usually help to distinguish pneumonia, which is treatable with antibiotics, from embolism, for which little can be done under expedition conditions. ***Pneumothorax*** may be a cause of chest pain and dyspnoea. The trachea will probably be displaced and the typical resonance to percussion with diminished breath sounds assists diagnosis. Under expedition conditions, increasing dyspnoea suggesting tension pneumothorax can be relieved by makeshift release using an intravenous cannula.

Epileptic attacks will usually stop in a few minutes; otherwise, they will probably respond to intravenous or rectal diazepam.

Once again, the expedition doctor should have prior knowledge of the condition. Rectal tubes of diazepam should be made available to the immediate companions of an expedition member with epilepsy, with detailed instructions on their use.

Myocardial infarction. Soluble aspirin 300 mg (preferably chewed) has a thrombolytic effect and should be given. Effective pain relief may be a problem, as not all trek doctors are prepared to carry controlled drugs. Nalbuphine (Nubain) was a suitable alternative but is no longer listed in the BNF. Injectable Tramadol and/or diclofenac are possible alternatives for relief of severe pain. If controlled drugs are carried a Home Office export permit will be required in addition to an import permit for each country to be visited or passed through. Atropine may be used for bradycardia and lignocaine for tachycardia, but no other drugs are appropriate under expedition conditions. Prolonged cardiopulmonary resuscitation is unlikely to achieve positive results, as it will not be possible on trek to correct the associated metabolic abnormalities and provide suitable aftercare.

Diabetic emergencies. Diabetic ***ketoacidosis or coma*** are fortunately not as likely to occur on an expedition as is ***hypoglycaemia*** due to over-exertion and/or inadequate carbohydrate intake. Knowing that an expedition member has diabetes should warn the doctor that the early symptoms of what appears to be acute mountain sickness, hypothermia or dehydration could instead be hypoglycaemia. Ketosis could occur, however, especially if some other illness or infection occurs. Ampoules of 50% dextrose for the treatment of hypoglycaemia have a tendency to break and convert the medical kit into a disgusting sticky mess. Glucagon injection, Hypostop oral gel and/or easily absorbable carbohydrate should be carried by diabetic expedition members and their immediate companions instructed on their use.

Surgical emergencies

There are few surgical problems that can be dealt with on trek, hence the scanty surgical kit advised.

Abdominal emergencies. There is little that can be done about problems such as ***appendicitis***, apart from giving a broad-spectrum antibiotic plus metronidazole in the hope of minimising the consequences of gangrene or perforation of a viscus. ***Ureteric or biliary colic*** will probably respond to diclofenac injections. ***Acute cholecystitis*** and urin***ary tract infections*** will need a broad-spectrum antibiotic, the former possibly with metronidazole added.

Major trauma

The principles of dealing with serious trauma on an expedition are those of all good first-aid, namely to preserve life and to minimise further damage pending evacuation for secondary care. Immobilising ***fractures*** using Cas-Straps and, when necessary, improvised splints, preservation of the airway in the unconscious and pain relief for the conscious are the main achievable objectives. Ski sticks, tent poles, ice axes or other rigid pieces of equipment are useful as makeshift splints. Inflatable splints have the disadvantage of being easily punctured and are easy to over-inflate, to the detriment of the circulation in a limb. Broad-spectrum antibiotics should be given for open fractures. ***Fluid replacement*** following serious trauma is a great problem, as it may not be possible to carry large quantities of intravenous fluids, especially on a small expedition. The logistics of an expedition will not always allow such fluids as

are carried to be available when needed. If logistics allow, both electrolyte and plasma volume expanding fluids should be available in a mobile emergency medical kit, with further supplies available at the most forward point possible for continuing treatment. Where no intravenous fluids are available in an emergency, rectal fluids, which should as far as possible be pathogen- and pyrogen-free but need not be completely sterile, may be given via a urinary catheter inserted into the rectum.

Medical and first aid kits for expeditions

The most frequently used medications on many expeditions are likely to be oral rehydration solutions, antidiarrhoeal drugs, simple analgesics and antibacterial drugs. The most frequently used first-aid items are also likely to be commonplace items such as Elastoplast, antiseptics and simple dressings.

It is best to assume that each member of the party will need these high-use items on at least one occasion or for one full course. For all other items, it is probably safe to assume that the quantities needed will be for about 10% of this "worst case scenario". Allowances must be made for treating porters, whose numbers will not be known before starting the expedition but who will probably at least double the size of the party. Other passing travellers may also need emergency treatment, which it would be difficult to refuse. Policy about treating local inhabitants depends on the philosophy of the expedition and the individual doctor. Again, it would be difficult to withhold emergency treatment, but any other treatment is probably best left to whatever local resources exist, however primitive they may appear, which will have to continue after the expedition has moved on. The expedition doctor will make little impact on most problems without good communication with local people in their own language and knowledge of their culture and circumstances. Nor will he or she be able to give continuity of care.

Packing. Tablets and capsules may be left in their original packs or removed from themand put in small self-sealing polythene bags to save space and weight. Glass ampoules may be packed in cotton wool or bubble plastic in similar bags or left in their original packs. Damage is unusual if tablets and ampoules are packed tightly. Plastic food boxes with well-fitting lids make suitable containers, and the lids may be held in place more securely by using stout rubber bands or Velcro-fastening elastic tourniquets. For larger expeditions these containers are usually transported in stout plastic drum which are resistant to water and to careless handling. For smaller expeditions one of more kitbags may be sufficient to hold the medical supplies. Each box or drum should be labelled indelibly with its contents, as should each bag, which should also carry details of dosage. The individual boxes are then packed into a crate or kitbag clearly labelled as medical equipment. A group check-in, if allowed, at the departure airport will usually ensure that there are no difficulties caused by this apparent excess baggage carried by the doctor, but if necessary, the kit could be split between party members to comply with airline weight restrictions.

Logistics. Unless the expedition doctor intends to carry a substantial load, one or more porters will carry most of the equipment. It will therefore be necessary for the doctor to carry a smaller kit for use on the trail. The bulk of the kit should be made the responsibility of a single porter or group of porters selected for reliability. The doctor should always know his whereabouts and ideally he should never be far from the doctor, especially if he is carrying, for example, the only cylinder of oxygen for a trekking

party on a high pass. If expedition members are likely to disperse widely, as on some climbing or fieldwork expeditions, it may be necessary to issue each member with an ***individual first-aid and medical kit*** to deal with the problems most likely to occur, at least until they are able to contact the doctor. The contents of such a kit would depend on the nature of the expedition. Contents would need to be clearly labelled with details such as indications and dosage. For an expedition with a ***fixed base camp***, the bulk of medical supplies should be kept at this fixed point, but if the whole party moves onward in stages from its base camp, as is the case in some climbing expeditions, an ***advance base kit*** would be needed. The doctor will usually need to compile his or her own ***mobile kit*** to be able to react rapidly to emergencies wherever he or she is.

Basic expedition medical kits

The following are examples of medical kits that can be used for climbing and trekking groups, with which the bulk of the author's experience has been gained. The contents of these kits may be added to according to the preferences of the individual doctor, the specific needs of the expedition and its carrying capacity. The contents of the "doctor's expedition kit" shown can be fitted into two or three small to medium sandwich boxes:

Doctor's expedition kit

Diagnostic

- Stethoscope
- Anaeroid sphygmomanometer
- Lightweight auriscope/opthalmoscope (optional)
- Pen-torch
- Urine dipsticks
- Blood glucose strips
- Tongue depressors
- Fluorescein strips

Emergency drugs

- Strong analgesic (e.g. diclofenac and ~~nalbuphine~~ tramadol injections)
- Adrenaline injection 1/1000
- Hydrocortisone injection
- Dexamethasone tablets and injection (for high-altitude cerebal oedema)
- Nifedipine capsules (for high-altitude pulmonary oedema)
- Diazepam injection

Other drugs

- Paracetamol tablets
- Loperamide capsules
- Rehydration sachets
- Ciprofloxacin tablets
- Metronidazole tablets
- Acetazolamide tablets (for acute mountain sickness)

First-aid

- Antiseptic sachets/swabs
- Non-stick dressings
- Sterile gauze swabs
- Micropore tape
- Elastocrepe bandage
- Conforming bandage
- Traingular bandage
- Assorted adhesive strip plasters
- Safety pins
- Scissors
- Airway
- Set of Cas-Straps (carried in its own wallet)

Main medical kit

Eye preparations

- Fluorescein drops
- Amethocaine drops
- Chloramphenicol drops or ointment
- Aciclovir eye ointment

Ear preparations

- NeoCortef drops

Nasal preparations

- Otrivine drops

Analgesics

- Paracetamol tablets
- Ibuprofen (tablets and gel)

Anti-infective

- Ciprofloxacin tablets
- Metronidazole tablets

Antidiarrhoeal

- Loperamide capsules
- Rehidrat or Dioralyte sachets
- Codeine phosphate tablets (also useful as a strong analgesic and cough suppressant)

Anti-emetic

- Prochlorperazine tablets (Buccastem buccal preparation is very useful or metoclopramide tablets and/or injection)

Throat lozenges

- Any variety (little therapeutic effect but a useful placebo)

Hypnotic

- Zopiclone tablets (useful for short-term readjustment after crossing time zones)

Antihistamine

- Chlorpheniramine (tablet and injection)

Skin preparations

- Antibacterial (e.g. Flamazine or Bactroban creams)
- Antifungal (e.g. clotrimazole cream)
- Topical steroid cream (medium potency) (e.g. betamethasone 0.1%)

Reserve supplies of all drugs and dressings in doctor's kit

Expedition surgical kit

- Disposable scalpel
- Dissecting forceps
- Small artery clip
- Stitch holder
- Scissors
- IV cannula
- Sutures
- Local anaesthetic (e.g. lignocaine)
- Stitch cutter
- Steristrips
- Lignocaine injection
- Ketamine (if experienced in its use)
- Skin-cleaning solution
- Gloves
- Foley catheter
- Nasogastric tube

Medicolegal aspects of expeditions

Under UK law, a practitioner can only be found to be negligent if there was a legal ***duty of care*** to an individual, there was a ***negligent breach of that duty***, and that ***damage was suffered*** as a result of that breach. By undertaking to provide medical care for an expedition, a practitioner assumes a duty of care towards the expedition members whether accompanying the expedition or not. It follows that a practitioner who fails to provide proper care and attention during an expedition may be found to have been negligent if that lack of care or attention has resulted in damage to the health of an expedition member.

The usual legal definition of what constitutes appropriate standards of care has long been the so-called "Bolam test", established by the case of Bolam v Friern Hospital Management Committee 1957. This describes appropriate standards as "the standard of the ordinary skilled man exercising and professing to have that special skill; a man need not possess the highest expert skill at the risk of being found negligent". The Bolam ruling goes on to say: "It is sufficient if he exercises the skill of an ordinary competent man exercising that particular art". The implication of the "Bolam test" is that it is not necessary to be an expert to avoid being negligent, but it is necessary to practice to the same level of competence that could reasonably be expected of any other "ordinary" practitioner in similar circumstances. The corollary to the Bolam decision is that if special expertise is claimed, a higher level of expertise (and therefore a higher standard of care) will be expected. The case of Wilsher v Essex Health Authority 1986 established, however, that "an emergency may overburden the available resources, and if an individual is forced by circumstances to do too many things at once, the fact that he does one of them incorrectly should not lightly be taken as negligence". The Wilsher judgement implies that if an individual is practising his or her profession in less than ideal circumstances, the recipient of those services cannot expect the same level of care that would be given in more ideal circumstances. Expedition members cannot reasonably expect that the care they receive in the field will be of the same standards that they could expect in the accident and emergency department of their local district general hospital. The case of Bolitho v City and Hackney Health Authority 1997 has been seen as a challenge to the "Bolam test". This case established that the "reasonable practice" defence must be supported by a "logical argument" based on risk-benefit evidence. It is no longer adequate to show that others would have done as you did, but it must be demonstrated that your course of action was reasonable in the circumstances.

Before acting as an expedition doctor, it is advisable to agree with the expedition team and organisers what standards of care will be possible and what limitations will be placed on that care. It may depend on factors such as the philosophy of the expedition, its equipment-carrying capacity, the degree of risk involved, the level of expertise of the doctor and the availability of evacuation and secondary care.

On ***commercially organised expeditions*** in which a practitioner is employed by the organisers of an expedition or trek to provide medical care, the organisers are responsible for ensuring that the doctor employed has the necessary training or expertise. The organisers are legally liable if they do not exercise reasonable care in their selection. The question of whether or not a practitioner is employed by the organisers may not depend entirely on whether payment is received by the practitioner. The provision of travel and/or accommodation free of charge or at a reduced rate would probably be interpreted as payment in kind. The practitioner still has his or her own duty of care, subject to the provisions of the Bolam and Wilsher rulings as modified by the Bolitho ruling, and could still be the subject of litigation, as could the organisers. The organisers may not be legally liable if they engage the practitioner as an independent contractor unless it could be shown that they had not exercised reasonable care in selecting a practitioner with adequate qualifications or experience.

Providing drugs for expeditions. A practitioner who does not accompany an expedition but who provides drugs for use by non-medical expedition members retains a duty of care towards those who take the medications. On some occasions, a practitioner who does accompany the expedition may provide drugs to be administered by others in his or her absence when, for example, logistics demand that the team is scattered over a wide area. The practitioner's duty of care still applies. It is essential that all such drugs are labelled with their names and clear instructions about indications and dosage, contraindications and possible adverse effects.

Prescription-only drugs. It is a breach of the Medicines Act (1968) for non-medically qualified persons to select and administer prescription-only medicines (POMs) without a specific instruction or prescription for the named patient. Breaches of the Medicines Act are a criminal offence. The problem of breach of the Medicines Act can be overcome in clinical practice by use of a Patient Group Directive (PGD). A PGD is a specific written instruction under which nurses or other health care workers are able to supply and administer named medicines in identified clinical situations to specific groups of patients who may not be individually identified prior to treatment. PGDs were not conceived as a means of enabling those who are not recognised health care professionals to select and administer POMs. It is not clear whether, for example, a trained first-aider is a health care professional. It may, however, be advisable to adopt the PGD approach when delegating administration of medicines to other expedition members who are not health care professionals, at least until such an approach has been legally tested in a court of law. A PGD must be constructed for each POM and must contain:

- the names of the drug, its dosage and methods of administration
- exactly when and to whom each medication can be given
- who is authorised to give it (this must be a named person or persons)
- how to record what, how, to whom and what dose has been given
- how to identify and manage adverse reactions
- the names of the authors of the PGD
- any professional bodies by which it has been approved
- the date and signatures of all named parties.

Medical defence. Practitioners accompanying expeditions abroad will in most circumstances be covered by their defence bodies for litigation arising out of the care of expedition members, but they must contact their defence organisation before travelling to ensure they will be covered. Cover, at least by the medical Defence Union, is unlikely to include acts performed in US territory, on US aircraft, in US airspace or on aircraft likely to land in the US, or for help given to US citizens; in other words, cases likely to be heard in a US court. Cover is also unlikely to extend to Canada, Israel, Hong Kong, Zimbabwe, Australia, or Bermuda. In spite of these cautions, medical defence organisations will now give worldwide cover to members for acting as a "Good Samaritan" in an emergency. The Medical Defence Union has stated that this does not include acting as an expedition doctor in excluded countries.

Registration. Expedition doctors will not necessarily be registered to practice in the destination country. It is advisable to check with the embassy or consulate of the country or countries to be visited. Full registration may not be needed for expedition doctors in all countries, and it is advisable to take a copy of the UK registration certificate along with the usual travel documents. Registration in the destination country may be a pre-requisite for treating residents of that country, which is another reason for not undertaking such treatment. The position of porters in this respect has not as far as the author is aware, not been tested in a court of law.

Communications and Casevac

Good communications between expedition members and with the outside world are important for the effective running of an expedition. Within the expedition VHF radio may be used, and in some areas it may be possible to use mobile phones, though this is unlikely in remote areas. To communicate with the outside world it may sometimes be possible to use mobile phones. Otherwise radio or satellite phones may be used. Many larger expeditions carry laptop computers, enabling them to use email communication. This also opens up the possibility of using telemedicine to assist in the management of medical or surgical emergencies.

Casualty evacuation is necessary when an expedition member is unable to continue because of illness or injury and cannot be adequately managed in situ. It must be planned in advance so that all members are familiar with the procedures.

Prioritising casevac cases may be carried out according to the following categories:

1a	Needs immediate evacuation from his/her current position
1b	Needs immediate evacuation but can first be transferred to a safer position
2	Needs evacuation within 12 hours
3	Needs evacuation within 24 hours
4	Needs evacuation but may safely wait over 24 hours

It is essential to know in advance what resources are available for a casevac. In addition to the expedition members themselves there may be hired staff such as porters, local people and, in some area, facilities such as a mountain rescue and/or helicopter service, though outside the UK this is likely to be expensive. It is also essential to find out prior to travel about local and regional medical facilities. The expedition's insurers may be able to assist with evacuation and/or repatriation and British embassies or High Commissions may be able to help to co-ordinate evacuation and subsequent care. Contact details for all these agencies will need to be available to expedition members.

Any incident requiring casevac should first be reported to the team leader and/or base camp manager giving the degree of priority and exact location. The leader/manager should then instigate action via whichever of the above services are appropriate or available to evacuate the casualty to the chosen destination for assessment. Information about the casualty and the progress of the evacuation must be

shared between the team medic, all medical staff involved in transporting or receiving the casualty, the team leader, base camp staff, contacts at the UK or other home base and possibly with the whole team.

The medic or first aider who is to accompany the casualty during the evacuation should not act alone, as there may be a need for doing several tasks at once which could nor be managed by one person. Those likely to act in this capacity should have small kit bag ready with their personal requirements for a journey should they be called on. They should carry their own and the casualty's passport, a copy of the casevac plan and a means of recording clinical observations during the journey. They will also need their own and the casualty's travel documents, means of payment for necessary services during the journey and a means of communication such as a mobile phone.