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## FOCUS ON...TROPICAL MEDICINE & HYGIENE

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### Preparation for deployment abroad

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#### Introduction

There can be few military medical missions more potentially critical than the preparation of a force for a foreign deployment. Every attempt is made during the tropical medicine component of the postgraduate medical officers' course to convey some sense of the basic nature of life in much of the developing world. In civilised countries, the widespread availability of potable water, efficient sanitation, a reliable electricity supply, communications and health and other emergency services, is all too often taken for granted. Recent deployments by the armed forces have been to countries where such infrastructure is rudimentary, if not non-existent, or where natural disaster, civil strife or war have produced significant disruption.

Unfortunately, it is only as a consequence of personal experience of such circumstances during foreign operations and an awareness of the consequences for affected civilian populations that the full impact becomes apparent. In most situations, therefore, no assumptions can be made concerning the availability of what may be, at the best of times, overstretched local facilities. Such facilities become overwhelmed if the local population manifests only a small increased incidence of communicable disease let alone epidemic proportions. This combination constitutes the worst possible scenario, resulting in a human reservoir of infection exposure which threatens immigrant military forces. It may therefore be a military as much as a humanitarian or political expedient to ensure that the local medical problems are included in any assessment and that provision is made for their containment. Encouraging non-governmental relief agencies to tackle this could well be more than an exercise in public relations.

In addition to local deficiencies, there are the ever-present environmental stresses such as heat, humidity, cold, floods and altitude. Many foreign operations involve exposure to vectors and pathogens rarely, if ever, encountered in temperate climates. The rapidity of deployment often limits the extent to which detailed medical planning is possible making pre-emptive contingency planning an important component of overall military medical strategy. However, failure to take advantage of every opportunity to refine this in relation to specific impending

circumstances increases the risk of compromise, if not failure, of the military mission. Counsels of perfection concerning acclimatisation and timely immunisation or ingestion of chemoprophylactic substances may be impossible. The consequences of unavoidable morbidity and attendant mortality have to be considered and appropriate provisions made. National press articles have pointed out that staffing levels in the armed forces have never been lower in two centuries while the number of military missions, mainly land operations, has never been greater outside general war than it is at present. To meet these requirements, intra-operational health maintenance must be a high priority not only for the current mission but also to meet the needs of those that now appear to follow with ever-increasing frequency. No longer is there the luxury of relatively limitless staff. The effective and safe use of modern military equipment demands considerable intelligence and training of personnel: immediate replacements are often not available. It falls to the members of the Defence Medical Services to ensure that, so far as the available resources permit, the operational readiness of the British armed forces is not compromised for health related reasons. This article attempts to raise the profile and to tackle these important issues.

#### Strategy

In order to conserve effective military strength, the medical objective when preparing for deployment abroad is to minimise the threat of medical problems by producing a plan of medical countermeasures which is based on a comprehensive relevant health appreciation.

#### Health appreciation

From what has been stated so far, health appreciation is as important as any other aspect of mission planning. While it may not be possible to anticipate and prepare for every medical contingency, failure to undertake any planning places the success of the military mission at considerable risk in proportion to the size of the force being supported. Information of different kinds and from different sources is essential for a successful health appreciation, a prerequisite if an appropriate and sustainable medical plan is to be devised.

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## Desirable Information

Deployment may mean that more than one geographical area will be encountered during transit to the ultimate destination. Different modes of transportation may incur different problems. For example, transport by ship may cause sea-sickness, increase the risk of communicable disease during the passage owing to unavoidable overcrowding and expose personnel to medical hazards at any ports of call additional to those at the destination. Alternatively, passage by sea can have the benefits of isolating the force from hazards on land. The problems likely to be encountered during a peace-keeping mission where the probability of close contact with the local population is greater may be entirely different from those encountered during combat operations. In any location, the duration of deployment must be considered allowing for changes in medical hazards related to seasonal change and an increasing number of casualties which is likely to occur with longer deployments.

## Geographical

### *Terrain*

The nature of the terrain will give some indication of the likelihood of trauma related

just to troop movements. Mountains raise the possibility of falls, altitude sickness, vehicle and aviation incidents. In addition to natural hazards, military intelligence may indicate the presence of obstacles related to enemy activity such as mines and other forms of boobytrap, all of which carry the risk of particular injuries (Figure 1). Negotiation of freshwater that is relatively stagnant may involve the risk of exposure to vectors (mosquitoes and haematophagous flies) transmitting various viral, protozoal and metazoal diseases or to the diseases themselves such as melioidosis, leptospirosis, amoebiasis, schistosomiasis and hookworm dependent on location.

### *Climate*

Unlike the United Kingdom and a few other similar places (the Falkland Islands spring to mind) that have very changeable weather, many countries have a fairly stable climate which changes more or less predictably with the seasons. This means that it is possible to predict the likely conditions at the time of arrival and, dependent on duration, the conditions likely to be encountered throughout the deployment. Environmental hazards will include altitude, temperature and relative humidity with their attendant effects not just on military personnel but also on the pathogens and vectors of disease.

### *Demography*

In most developing countries, the indigenous population is young. A high infant mortality rate related to diseases, many of which are relatively preventable by timely immunisation or administration of antibiotics, fosters high multiparity with attendant obstetric problems and consequences for infant nutrition. A high level of sexual activity may result in high hepatitis B and human immunodeficiency virus carriage rates. Those that survive into adulthood may also harbour diseases such as malaria which have no apparent adverse effect on the indigenous population but which constitute a reservoir of infection for immigrants. Nomadic tribes with attendant livestock may constitute a mobile disease reservoir. The absence of a register of births and deaths may mean that no reliable information concerning demography is available.

### *Economy*

Deaths relatively early in life result in a population which is inadequately trained or resourced to sustain any significant economic activity beyond rudimentary agriculture and animal husbandry. This reduces the likelihood of availability of any local food to sustain the military force. This may be a blessing. Use of human faeces to fertilise crops may maintain various viral and helminthic diseases in the local population.

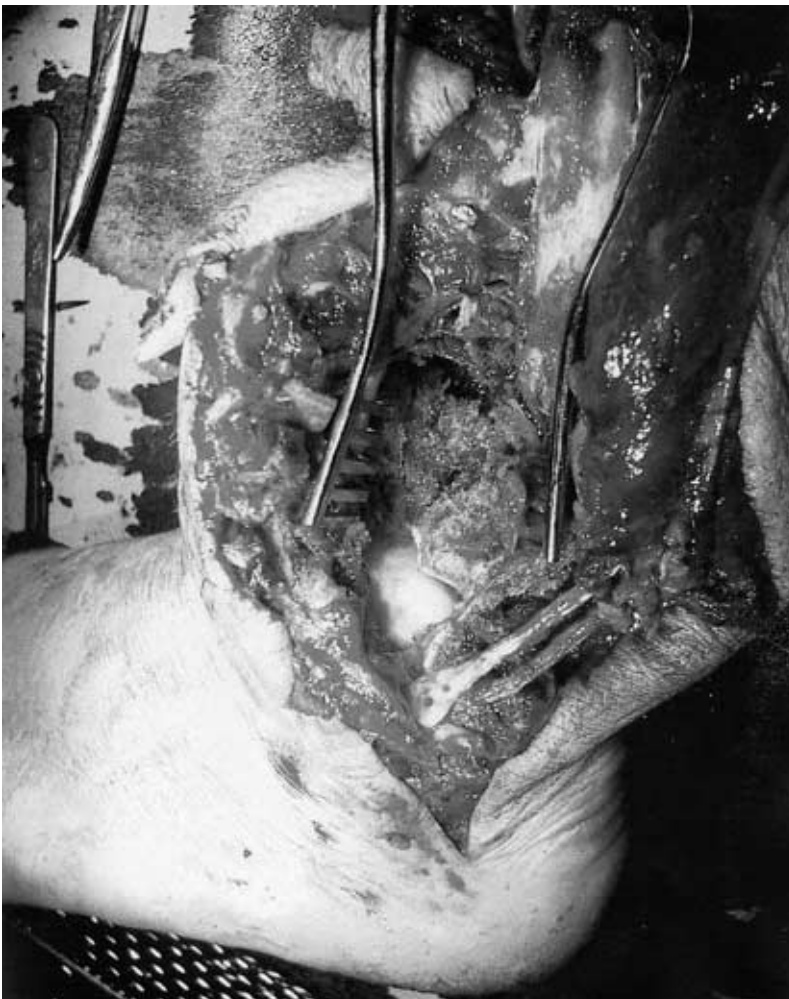


Fig 1. A minestrike victim. Avoidance of all areas suspected to be mined should prevent the devastating consequences of minestrike shown in this picture. Amputation was the only possible treatment.

Industrialisation is likely to be minimal and that which does exist may generate toxic gases and effluent to pollute the atmosphere and water sources with subsequent contamination of the food chain. Inadequate precautions related to handling of sources of radiation may constitute another potential hazard. There may be no time or resources for remedial action to combat these educational deficiencies but even if there were, a high illiteracy rate would hamper dissemination of information which is often dependent on visual sources such as videotape where the appropriate language may not be available.

#### *Infrastructure*

The infrastructure which may have survived previous belligerent activity may be sabotaged. That which remains may be unable to sustain any aspects of military activity or casualty handling. Provision of clean potable water and sanitation are essential in order to avoid water borne diseases such as cholera and typhoid. Power sources may be inoperative or unreliable in relation to continuity of electricity supply or its voltage. Movements of any size may be impossible if roads and railways are inadequate and bridges destroyed. Use of navigable rivers may provide an alternative but at the same time expose personnel to particular diseases. The staff of the quartermaster's department and any attached engineers should be asked about contingency arrangements to deal with any deficiencies. Aviation arrangements, particularly for rapid casualty movements to local hospital facilities, need to be in place as well as provision for repatriation.

### **Health Hazards**

#### *Prevalent diseases*

While much may be known of indigenous diseases, temporary increases in prevalence which may constitute epidemics may be unknown. Attempts should be made to establish contact with reliable sources of such information. Relief agencies, embassies and local medical staff can all be very helpful.

#### *Environmental factors*

Much of this has already been mentioned in relation to geography. Certain conditions are ideal for some species of snake and other wild animals which, whilst constituting a source of bites and venoms, may be reservoirs for such diseases as rabies. Local alcoholic beverages can be highly toxic if fermentation and distillation processes have been uncontrolled. Ice bearing pathogens may contaminate otherwise potable fluid. Unscrupulous local dealers may purchase quantities of well-known brands of tinned products which are out of date although the date by which they should be consumed has

been removed or obscured. The contents may be contaminated with serious intestinal pathogens. This should be suspected whenever tins are rusty, bent or distended by gas-producing organisms. Cans of soft drinks bearing small punctures can be infected by contaminated cooling ice-water.

#### *Medical capabilities*

The medical capabilities will largely depend on the size of the force being deployed, the magnitude of the medical threat and, significantly nowadays, the availability of suitably trained medical, nursing and technical staff. Medical resupply is of key importance. Casualty movement is dependent not just on the vehicle but also on the availability of appropriate attendants.

### **Sources of Information**

#### *Ministry of Defence Health Briefs*

Within the Army Medical Department, there is a Health Intelligence Unit which has access to military medical information from national and supranational (for example NATO) sources. All military medical officers should provide reports on their return from deployments to ensure that the reliability of such sources is maintained. Health briefs from this source should arrive as a matter of course once a decision to mobilise and deploy has been made by commanders of higher formations.

#### *Unit's previous instructions*

Where personnel are going to the location of a recent previous deployment, valuable information may exist within the parent unit. Both written information and personal recollection can be invaluable. There is no excuse for failing to seek and tap these potential resources in appropriate circumstances.

#### *Previous exercise reports*

Where foreign training grounds which are used on a regular basis are involved, previous exercise reports should exist. These can provide useful information concerning the spectrum of disease and casualty numbers. They can be potentially misleading when there is a changing susceptibility to therapeutic agents (for example resistance to anti-malarial medications) so vigilance after deployment is essential as are effective arrangements for notification and provision of alternative medication requirements should the need arise.

#### *Previous medical officer*

In the absence of written briefs, a predecessor may have the knowledge that is required. This source should not be forgotten.

#### *Preventive Medicine specialist*

Where any sizable force is being deployed, a

medical cell will be available at headquarters. The commander medical will be supported by a specialist in preventive medicine wherever possible. Notifications of morbidities and their rates from all units will be collated centrally, countermeasures devised and resources for implementation acquired within military prioritisation. Supporting telemedicine facilities should be available at this level but enquiries should be made concerning provision of this at the level of individual units.

#### *Civilian sources*

Handbooks (for example *Oxford Handbook of Tropical Diseases*) can be helpful for ready reference. If portable computing facilities are available, CD-ROMs may be a lighter, more compact and, hence, more convenient format to carry information but the possibility of technical failure should be considered before entire trust is placed in this medium. The internet now provides a new dimension for ready acquisition of information in amounts of potentially unlimited magnitude. Commercial search engines facilitate website location but to avoid delays, some preferred addresses should be acquired and validated before deployment. Provided the source concerned is reliable (for example websites maintained by the UK Public Health Laboratory Service, US centers for Disease Control and Prevention, the major international medical journals and the World Health Organisation), the information should be helpful: sources which are not subject to peer review should be avoided. However valuable, no undue reliance should be placed on sources of information which are dependent on any form of telecommunication which is susceptible to hostile disruption. All of these sources often lack detailed reliable local information which is always valuable. Such knowledge of disease prevalence, antibiotic sensitivities and anti-venom efficacy can be crucial and should not be disregarded before evaluation.

### **The Medical Plan**

Once a comprehensive primary health appreciation has been concluded, a preliminary medical plan can be devised. It should be constantly remembered that new sources of information can arise at any time and potentially change the health appreciation significantly. This may have major implications for medical planning. The situation may need constant reassessment and revision. Adoption of a complacent attitude should be avoided.

### **Preparation of the Individual**

To meet general military requirements, the routine assessments of medical (PULHHEEMS) and dental fitness should be efficient with access to individual and

collective readiness for deployment instantly available. With modern database programs, there should be no excuse for failure to acquire this information rapidly. Individual medical documents (F Med 4) should be complete. Immunisation records should be assessed and any deficiencies remedied on an individual basis. Where a specific threat is perceived for which no prior protection has been provided, vaccination of the whole unit will be required when appropriate. Rabies and Japanese B encephalitis are two examples of this.

Chemoprophylaxis may be essential for such diseases as malaria. All drugs have an adverse event rate and anti-malarial drugs are no exception. Throughout rural sub-Saharan Africa, the current licensed drug of choice for most military personnel is weekly mefloquine. Apart from those who have documented sensitivity to this drug, the only group who have to take alternative medication are aviators. Although controversy has surrounded the use of this drug, the adverse event rate is not significantly greater than that of chloroquine-proguanil in male military personnel, a group already screened for absence of a personal or family history of epilepsy or psychiatric disease. Another alternative to mefloquine is daily doxycycline although it is not licensed specifically for anti-malarial chemoprophylaxis. Other compound medications taken on a daily basis may eventually become available. Chemoprophylaxis should be started at least one week and preferably two weeks before departure to ensure adequate protective blood levels and to identify any cases of intolerance so that alternative medication can be provided.

In addition to recorded information, there should be no question as to whether each person knows his own blood group. Only blood screened for blood-borne viruses is to be transfused other than in the most dire of circumstances. In countries where there is a high risk of carriage of such viruses, blood from members of the local population should be handled with utmost caution at all times. Supplies of disposable rubber gloves should be readily available for protective purposes.

Spare of personal items, such as spectacles, the loss of which would seriously impair performance, should be taken. Ear defenders provide significant aural protection and no unit members should be without them. Those who are taking regular medication for conditions for which they are not downgraded such as mild to moderate hypertension should be encouraged to ensure they carry an adequate supply, bearing in mind that the duration of the deployment may alter.

Disease warning cards such as alerts for malaria should be issued to unit members so that there should be no question that appropriate diagnoses are considered in the

event of illness, particularly febrile illness, after returning to the UK.

## Collective Preparation

### *Training*

All basic assessments of fitness for current military duties should be complete. Apart from ensuring aggressive capability, personnel who are physically fit are better able to withstand and survive serious insults whether from trauma, burns or infection or any combination. First aid skills may mean the difference between life and death for injured comrades before trained assistance is available. Confidence in the safe handling of all weapons should minimise the risk of serious accidents. Particular attention needs to be paid to driving conditions, since road traffic accidents remain one of the most common causes of injury during deployments (Figure 2). The threat from mines should be assessed and appropriate training in practical skills to minimise the risk from this hazard provided by personnel trained in disposal of explosive ordnance.



Fig 2. A DAF truck after collision with another vehicle in Bosnia. After sports injuries; which are relatively minor, road traffic accidents remain the most common cause of injury on deployments and usually are severe. Absolute care is essential when driving in countries where there is no accepted code of road conduct and roads are in a poor state of repair.

### *Equipment*

In locations where there is a serious threat from insects, physical measures provide significant protection. Combat kit and other items of clothing should be treated with permethrin and insect repellent creams provided. Bed nets should also be impregnated with permethrin. The importance of wearing boots at all times should be emphasised. These prevent bites from snakes and stings from scorpions. Boots also prevent penetration of hookworm and strongyloides larvae. Personal water purification tablets should have intact foil wrappings and be inside their expiry date. Water bottles should be serviceable and any defects must be remedied.

### *Supplies*

Personal supplies of first field dressings and morphine syringes should be correct.

Supplies of any special personal medications were mentioned previously. The stocks in medical boxes should have been checked at regular intervals. The medical box containing supplementary medical supplies for tropical locations should be requested. The number of boxes adequate to deal with the expected casualty rate should be available. All items of diagnostic equipment should be checked for serviceability.

### *Clothing*

Clothing appropriate for the temperate or tropical location of operations should be provided. The possibility of heat illness remains in any location but the probability increases in locations where operations occur demanding considerable physical exertion in some form of combat kit at times of high temperature and high humidity. All members of the unit should be aware of this risk and how it may be minimised where possible and of the measures to be taken when heat casualties occur.

## Provision of Medical Treatment

### *Medical personnel*

Whatever the size of the medical facility, the numbers of medical, nursing and other staff have to be sufficient for the size of military formation it is intended to support. No hard and fast rules govern this but consultation rates in tropical areas are likely to be approximately double those in temperate areas. While economy has to be observed, attempts to cut staffing to unrealistic levels should be resisted. The nature of the pathology may be different and briefings for medical staff will be important to boost confidence in ability to meet such challenges. In part, anxiety related to location and the ever-present feelings of impotence in relation to domestic problems arising during deployment will lower the threshold for military personnel to seek medical advice. The medical staff should adopt a high profile during pre-deployment training to which they should make a substantial contribution so that potential problems are discussed, concerns addressed and likely treatment protocols explained. In short, medical staff have to make their contribution to the morale of the force: there should be no lack of confidence in the ability of the medical staff to deal effectively with their areas of responsibility.

### *Location of unit medical facilities*

Medical facilities have to be readily accessible on foot and by vehicles with no undue separation from water, sanitation, communications and power supplies. Medical staff accommodation and a rest area have to be co-located with the medical facility which has to include adequate storage facilities for medical supplies bearing in mind the necessity for some degree of

environmental protection. The facility should be in as safe a location as possible. Wherever possible, the medical facility should be close to the headquarters, cookhouse and chaplain and, while some separation from the helicopter landing site is inevitable, a clear pathway for vehicles to transfer casualties is essential.

#### *Preparation to deal with mass casualties*

Some thought needs to be given to triage so that provision is made to deal with situations where the potential exists for unit medical services to be overwhelmed. The basic elements of triage need to be explained to all unit personnel so that they have some understanding of how to deal with mass casualty situations when medically-trained personnel are not at the scene. All medical staff should be aware of triage criteria and their contribution to the management of the different categories of casualty and the location of facilities to deal with them.

#### *Local facilities*

A reconnoitre of local civilian medical facilities should be a relatively high priority in order to discover their strengths and weaknesses and to make contact with professional colleagues. Local supplies of medications and disposable medical equipment may be essential on occasions. Assessment of local hospitals and laboratories may have been undertaken already but it is essential that the medical officer at least introduces himself.

#### *Casualty evacuation*

Definitive treatments for persisting medical problems are now the responsibility of the National Health Service and inevitably involve medical evacuation by air. The chain for casualty evacuation has to be established

from the start. Movements by road and air to the airhead have to be co-ordinated so that no undue delays or compromise of maintenance treatment occur. The Royal Air Force medical evacuation service provides an aeromedical evacuation liaison officer (AELO) whose responsibility, in consultation, is to prioritise casualties for evacuation and to provide suitable accommodation and attendants on board aircraft. The whole movement is co-ordinated centrally so that the casualty arrives in good condition at a hospital under the care of a consultant forewarned of the arrival of the patient. Some thought should be given to the disposal of local civilian patients who may receive emergency medical treatment from military units. Civilian hospitals need to be identified for this reason if for no other (Figures 3 and 4).



Fig 4. A Sea King helicopter in Sipovo, Bosnia. Aeromedical evacuation assets are most valuable to ensure timely evacuation of patients so that military medical facilities are empty to receive the next casualty.

#### *Blood transfusion*

Correct storage facilities for blood are essential. Cabinets have to be fitted with monitors which indicate excessive temperature variations. As mentioned above, only blood screened for blood-borne viruses is to be transfused in other than the most dire of circumstances.

#### **Health Information**

Provision of information in an easily assimilable form should promote avoidance of disease. The main causes for consultation are work-related trauma, sports injuries, gastrointestinal diseases, arthropod-related problems, respiratory conditions and the effects of the climate.

#### *Work-related trauma*

Wherever possible, observance and implementation of protocols produced by the Health and Safety executive are mandatory throughout the Services. These remain the responsibility of the professional group concerned. Surveillance of all incidents which could potentially result in injury are the core of such schemes with the objective that remedial action is taken to prevent any recurrence of the incident. By



Fig 3. The author at the Russian Military Hospital in Pristina, Kosovo, having visited to make the acquaintance of medical staff to seek their co-operation in the event that a large number of civilian casualties overwhelmed British facilities.

the very nature of operational locations and the equipment involved, military activity will always be associated with increased risks. However, there is never any excuse for these not being minimised and medical staff have the responsibility to bring an increased incidence of work-related trauma to the attention of the commanders of units affected. This is one way that the Defence Medical Services contribute to maintenance of operational strength and the success of the military mission.

#### *Gastro-intestinal disease*

Use of local restaurants should be forbidden. It should be explained that much planning goes into the provision of food and water from uncontaminated sources. Careful food preparation and storage by the cookhouse staff and use of disposable plates and cutlery can all be undermined if food from elsewhere is consumed. 'Compo' rations may be boring if they are the only source of nutrition but they are at least safe. Local produce may have been fertilised with animal or human faeces bearing disease and, if washed, the water used to wash such food may be contaminated. It should be pointed out that while episodes of diarrhoea, vomiting and abdominal colic could be due to communicable disease, there are other causes such as inflammatory bowel disease and medical advice should be sought for all cases where prompt recovery fails to occur.

#### *Contact diseases*

With proper selection and preparation, the military force should be fully fit on deployment. Prevalent communicable diseases among the population in the area of deployment should have been identified and preventive action taken beforehand wherever possible. Diseases due to direct contact for which no immunisations are available are mainly dermatological or sexual. The former are largely infestations due to lice or fleas. Impregnation of clothing with insecticides (eg permethrin) may help only if the clothes are kept on. Impetigo contagiosa and erysipelas are possible and appropriate antibiotic treatment will be curative. Freshwater bathing in lakes where such diseases as schistosomiasis are prevalent should be forbidden but the possibility that such contact may be unavoidable for military reasons should be considered and provision made for post-deployment screening. Abstinence from sexual contact with the indigenous population is the ideal to promote. Realistically, it is best to assume that contact will take place. Barrier methods of contraception should be freely available to all troops on deployment. The importance of using condoms should be stressed at every opportunity. Excessive alcohol consumption

is a particular factor likely to increase the risk of sexually transmitted infections. Abstinence from alcohol or only moderate consumption are the best safeguards. Troops should be encouraged to seek medical advice if sexual contact does take place if for no other reason than the provision of immediate post-exposure prophylaxis for human immunodeficiency virus. This is an essential consideration in medical units dealing with the local population in most tropical areas but particularly in Africa.

#### *Arthropod-borne diseases*

Where arthropods, mainly insects, bearing diseases are a problem, the physical barrier provided by the use of clothing and bed nets should be emphasised. Permethrin impregnation is helpful but no substitute for keeping sleeves down, boots on and for bed nets being used. Creams which repel arthropods should be freely available as should insecticide sprays. The inside of tents and buildings should be sprayed with insecticides before retiring. Use of insecticides vapours or traps should be encouraged. Animals are a particular source of arthropod-borne diseases. Acquisition of domestic pets should be forbidden and any animals straying into the area of the camp should be eliminated. Both animals and arthropods are attracted by food scraps which, like all rubbish, should be properly disposed of, preferably by burning.

#### *Airborne diseases*

Airborne transmission of tuberculosis is the main concern where close contact with the indigenous population is unavoidable. Although less important respiratory pathogens are likely to be encountered, troops should be informed to avoid approaching people who appear underweight with chronic coughs and easy fatiguability. In sub-Saharan Africa, nasal carriage of meningococci is prevalent and the importance of seeking advice when a non-blanching rash is apparent should be emphasised.

#### *Climatic effects*

Hot countries raise the risk of heat illness. A simple grading system reflecting the wet bulb globe temperature (WBGT) index of susceptibility should be adopted and be easily visible. Where circumstances permit, strenuous activities should be avoided until a 3-week acclimatisation period has passed. It should be stressed that it is the responsibility of all members of the military force to ensure that those experiencing disturbances of consciousness or ataxia or both in circumstances where heat illness is a possibility should receive prompt attention to reduce core temperature before being passed down the medical chain of care. In

cold climates, heat illness is still a possibility when activity in heavy clothing takes place. Cold injury will be more likely and is avoided by keeping extremities warm and dry. Impervious layered clothing and good well-fitted boots which can be replaced if unavoidably made wet is the key to avoidance of this problem. High altitude brings not only the problems associated with cold but also those associated with hypoxia. Troops should be told the warning signs of high altitude pulmonary and cerebral oedema and the need to make for provision of rapid descent for those affected.

### **Conclusion**

Medical preparation for deployment of a force abroad is a major undertaking. Every source of advice should be consulted but even with the best of plans situations, can arise for which no or inadequate provision

has been made. Facilities for telecommunication for medical advice and supply of medicines and equipment not available locally are always desirable but the need for them will be minimised if careful thought is given to the challenges likely to be encountered.

### **Acknowledgements**

Personal experience has been supplemented by accounts and advice received from many medical colleagues who have worked abroad, both military and civilian and too many to mention individually, over several years. However, special mention needs to be made of my colleagues in the Department of Preventive Medicine at the RDMC whose thoughts have been a seminal influence in the content of this article. An attempt has been made to incorporate as much of all this knowledge as possible.