Health countermeasures for military deployment

ABSTRACT
Military deployments represent a significant logistic exercise in occupational health. Health countermeasures are important to deal with medical, dental and psychological problems that may be pre-existing or arise during or after deployment. In terms of infectious disease, vector-borne diseases, in particular malaria and the arboviruses, stand out as major concerns for military deployments. However, other common problems, for example diarrhoeal disease and motor vehicle accidents, also need to be addressed. Military forces contribute to the development of guidelines and policies for delivery of effective health countermeasures associated with deployment of troops.

INTRODUCTION
Military forces frequently deploy to areas that are characterised by extremes. These can be extremes of environment, endemic disease, poverty, and inadequate public health measures; all in the context of inadequate local medical resources. Such conditions require proper preparation and follow-up of military personnel to prevent, manage and reduce the incidence of diseases and injuries that might compromise a deployment or the personnel’s well-being.1 Appropriate health countermeasures might include:

- Medical, dental and psychological assessments upon enlistment;
- Regular medical and dental assessments of fitness for deployments;
- Health education and psychological briefing of personnel;
- Provision of general health countermeasures;
- Provision of specific health countermeasures against potential terrorist threats;
- Provision of health support on deployment, which requires specialised training; and

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- Post-deployment health screening and psychological debriefing.

**PRE-DEPLOYMENT HEALTH EXAMINATION**

Pre-deployment health examinations primarily aim to:

- Assess whether the individual is medically suitable for work on deployment;
- Ensure that any allowable medical and dental conditions are under optimal control and are manageable in possible remote situations;
- Detect any medical, surgical or psychological problems that should be dealt with before deployment.²,³

Baseline screening for various communicable diseases, such as human immunodeficiency virus (HIV), hepatitis B and C viruses and tuberculosis, may also be undertaken depending on the health threats and screening policy.²,³

**PRE-DEPLOYMENT BRIEFING AND TRAINING**

There is an emphasis in military deployments that personnel have adequate pre-deployment health briefing and training, which might include:

- Health education concerning potential health and safety threats;
- Briefing concerning health and safety countermeasures required;
- Combat or advanced first aid training⁴,⁵; and
- Psychological briefing and training.

In addition to pay and allowances, military personnel may have access to workers’ compensation, death benefits and veterans’ entitlements, as well as on-site and off-site systems of medical, dental and psychological care, where they are on deployment, which should be included in pre-deployment briefings.⁴

**GENERAL HEALTH COUNTERMEASURES**

Health countermeasures depend on health threat assessment, available countermeasures, and prevailing guidelines and policies. There are a number of key national and international publications, which provide guidelines and advice for tropical medicine practice, such as *International Travel and Health.*² Access to policy guidelines and up-to-date health intelligence, usually assisted by access to Internet-based resources, is essential. Research undertaken by both civilian and military research institutes contributes substantially to the development of guidelines and policies for delivery of effective countermeasures to infectious diseases associated with military deployment.

**Vector-borne tropical diseases**

Vector-borne tropical diseases remain amongst the great problems for operational deployment of military personnel. The Addendum summarises these risks. Some vector-borne diseases also represent a potential public health problem when returning home. Malaria remains the single most important vector-borne disease problem of the military worldwide.

**Malaria**

Malaria is a serious disease caused by a protozoan parasite largely confined to the tropics. Most life-threatening cases and deaths occur due to infection with *Plasmodium falciparum* species of malaria.⁶ However, infection due to *P. vivax* also remains important, especially as dormant liver stages can cause relapses, sometimes several, for months after returning home.⁴ Standard malaria countermeasures will be considered as part of planning for operational deployment based on current policy and disease patterns in the area of operations. Current countermeasures against malaria include the use of malarial chemoprophylaxis, personal protective measures, environmental health measures against disease vectors, early detection and treatment, and malaria eradication treatment.⁶ Civilian guidelines for malaria chemoprophylaxis and treatment are provided by the World Health Organization (WHO).⁶

**Arboviral diseases**

There are many arboviral diseases, which have the potential to impact on military deployments. In Africa, yellow fever is a major concern for deployments.

**Yellow fever**

Military personnel are one of the high-risk groups for yellow fever.⁷ The WHO requires yellow fever vaccination for those travelling to endemic regions, including west and central Africa as well as a number of areas in south and central America. Vaccination with the attenuated live viral vaccine is mandatory for military personnel.

Photo: Albie de Frey
vaccine (17D) confers protective immunity for about 10 years.6 Yellow fever vaccination should be appropriately documented and a booster should be considered after about 10 years. Military personnel should also be fully briefed on personal protective measures to avoid bites from infected mosquitoes.

Dengue
Dengue is a viral illness transmitted by Aedes spp. of mosquito and is a major global public health problem. Infection may range from subclinical disease to fever, arthralgia and rash, or be complicated by haemorrhagic diatheses or shock syndromes. Treatment is supportive, while management of the problem is directed towards preventing transmission upon return home, which is a small potential risk in southern Africa. Numerous outbreaks of dengue can be attributed to travellers returning with the disease from southeast Asia. Until a vaccination becomes available, the mainstays of dengue prevention are personal protective measures and environmental health measures against disease vectors.6

Japanese encephalitis
JE, transmitted by infective mosquitoes, is the leading cause of viral encephalitis in Asia. Up to a third of clinical cases die and about one half of clinical cases of JE have permanent residual neurological sequelae.6 Despite the availability of a vaccine against JE, the immunogenicity of these vaccines has recently been questioned and concerns have been raised regarding adverse reactions reported with vaccination.6 The current development of safer and more immunogenic second-generation JE vaccines,8 if successfully trialled, will be important for future military deployments in JE endemic areas.

Filariasis
In Africa, soldiers may encounter several forms of filariasis, including lymphatic filariasis (LF), onchocerciasis and loiasis (see Addendum). LF is caused by three species of nematode parasites, which can be spread by a wide range of mosquito species.6 It has a widespread geographic distribution mainly in the tropical regions of the world. Wuchereria bancrofti is the most common and accounts for around 90% of cases.6 Brugia malayi is confined to east and southeast Asia and Brugia timori is found only in Timor and nearby islands.6 From World War II, there have been numerous outbreaks and reports of LF documented amongst troops deployed in southeast Asia and the western Pacific region.6 Countermeasures for filariasis include personal protective measures and eradication treatment.5

Rickettsial diseases
A number of rickettsial diseases have a significant potential to impact on military deployments.11 In Africa, ticks are important vectors of a number of diseases, including rickettsial diseases, such as African tick bite fever. Scrub typhus is widely endemic, particularly in a wide area of southeast Asia, Australia and the western Pacific region.11 There are no vaccinations for rickettsial diseases and prevention hinges on the use of personal protective measures by military personnel.12 Weekly doses of 200 mg doxycycline can prevent scrub typhus, but the efficacy of daily doxycycline for malaria chemoprophylaxis against Orientia tsutsugamushi is unknown.12
Vaccine preventable diseases
Many infectious diseases of travellers can be prevented by immunisation, as indicated in the Addendum. There are few mandatory vaccines, for which certification is necessary. These include yellow fever and meningococcal meningitis, which is prescribed by the World Health Organization. Meningococcal meningitis is of concern across the meningitis belt of sub-Saharan Africa, particularly in west Africa, and vaccination is warranted for deployment to these areas and other areas where the vaccine preventable strains of the disease are endemic. In addition to routine and national schedule vaccinations, there are a variety of vaccinations, which may be required for particular destinations. Influenza A and B are now considered major threats to military personnel in barracks as well as on deployment and influenza vaccination is starting to become more widely recommended.

Zoonotic diseases
Zoonotic diseases may present a hazard for military deployments in rural Africa as well as many other parts of the world. Zoonotic diseases of concern include rabies, leptospirosis, bovine tuberculosis, anthrax, plague, and even certain viral haemorrhagic fevers. Rabies is amongst the most important of the zoonotic diseases. It is widely endemic in Africa and other parts of the world and is an almost invariably fatal illness, spread by the bite of an infected animal. Military personnel are considered amongst the high-risk groups for rabies, and pre-exposure vaccination is indicated for troops deploying to rural Africa or other parts of the world where the disease is endemic and access to rabies immune globulin and post-exposure prophylaxis may be variable. Military personnel should be cautioned against approaching potentially infected animals and taught about first aid treatment of wounds caused by animal bites, including post-exposure prophylaxis. Leptospirosis is a widespread concern and is transmitted by infected domestic and wild animals, especially rodents. Military personnel coming into contact with urine-contaminated water may be infected. Rodent control measures need to be instituted in the field, as well as consideration of antibiotic chemoprophylaxis or eradication treatment. In Australia, doxycycline has been widely used to assist in prevention of leptospirosis and has been demonstrated to be both an effective chemoprophylactic and therapeutic agent.

Sexually transmitted diseases
Military personnel are often considered a risk group for sexually transmitted infections. In much of Africa and Asia, human immunodeficiency virus and hepatitis B and C virus are widespread. Pre-deployment, hepatitis B vaccination is important, as is hepatitis B and C and HIV serology, as baseline measures. Troops should be counselled on safe sex practices and preventing and managing percutaneous exposures to blood and bodily fluid.

Schistosomiasis
Schistosomiasis remains one of the most important tropical diseases with a widespread distribution in more than 70 countries throughout parts of Africa, Asia and South America. Schistosomiasis is an important health risk for military deployments to rural Africa, where it causes chronic gastrointestinal schistosomiasis (Schistosoma mansoni) and genitourinary schistosomiasis (Schistosoma haematobium). Apart from avoidance of potentially infected water bodies or using protective clothing when fording streams, screening serology could be offered pre-deployment and post-deployment. Soldiers who seroconvert should be investigated and treated appropriately, usually with praziquantel. Alternatively, stool and urine examination for parasites may be indicated for soldiers where infection is suspected, where serology is not available or not useful due to previous exposure.

Other infectious diseases
Other tropical diseases may affect military personnel on deployment. Prevention of diseases may require the use of personal protective measures by military personnel. Tuberculosis (TB) screening should also be considered for troops deploying from non-endemic regions to endemic regions. Active TB should be excluded in those exposed to TB or who are symptomatic. The importance of travelers’ diarrhoea should also not be underestimated in military deployments, and is an important part of pre-deployment health briefing. Skin infections are also common problems of deployments.

INFECTIOUS DISEASE RISKSPOSEDBY BIOTERRORISMAND EMERGINGINFECTIONS
The identification of the most likely and threatening of
the potential biological weapons remains a joint effort of civilian and military public health and medical experts, informed also by law enforcement and intelligence. The development of public health and medical preparedness measures must then be instituted or developed against those threats that merit special concern. Some of the important criteria for this determination should include feasibility of aerosol dissemination, high case-fatality rates, potential for secondary spread, and the availability of protective vaccines or antimicrobial agents. Among some of the major causes of concern in recent years have been smallpox and anthrax, for which vaccines and/or prophylaxis are available; however a range of viral and bacterial agents have been identified and classified according to the threat that they pose. There is also widespread stockpiling of anti-viral treatment countermeasures to the avian influenza virus, particularly for use by health and military personnel, who may be called out to assist in disease control of any outbreak of the disease in human populations. There is however no substantial evidence for the effectiveness of these drugs in avian influenza.

**Non-infectious hazards of deployment**

Sun exposure and heat illness remain a problem for soldiers, particularly on training exercises and military deployments. A US study by Carter et al showed that the diagnosis of the most serious form of heat illness, heat stroke, is actually increasing in terms of hospitalisation, although overall heat illness admissions reduced over the period 1980–2002. The complications of heat stroke, which can be life threatening – 37 US soldiers died during 1980–2002 – may include dehydration (17%), rhabdomyolysis (25%) and acute renal failure (13%). Injuries and accidents, especially fatal motor vehicle accidents and training injuries, represent a significant problem for military personnel on deployments. Other common problems include skin diseases, and field conditions.
during deployment, such as cold, sun exposure, heat, humidity and poor hygiene, can exacerbate skin disorders.\textsuperscript{22}

**POST-DEPLOYMENT HEALTH COUNTERMEASURES**

Post-deployment health countermeasures usually include the following:

- Post-deployment health and psychological debriefing;
- Eradication treatment for parasitic diseases, such as malaria and helminths; and
- Post-deployment medical examination and laboratory screening.

Not surprisingly, a study of US soldiers on peacekeeping deployment in Bosnia found that 77\% reported a positive consequence, such as additional money, self-improvement and time to think, and 63\% reported a negative consequence, such as problems with the military chain of command, being away from home and deterioration of marital/significant other relationships.\textsuperscript{23}

The provision of written advice, which may be as simple as a small purse or wallet-sized card, can be useful reinforcement of post-deployment health issues for the patient and the treating health service, particularly if the soldier is seeking medical attention for a potentially life-threatening illness, such as falciparum malaria. Although many military personnel remain in service post-deployment, many discharge, which requires an ongoing system of veteran’s health support in the event of disability or death arising during or after deployment. This can also be used for tracking soldiers, who may have been exposed, perhaps inadvertently, to a health hazard, especially when more becomes known about the hazards with time.\textsuperscript{24}

**CONCLUSION**

Military deployments represent a significant logistic exercise in occupational health. Health countermeasures are important to deal with medical, dental and psychological problems that may be pre-existing or arise during or after deployment. In terms of infectious disease, vector-borne diseases, in particular malaria and the arboviruses, stand out as major concerns for military deployments. However, other common problems, for example diarrhoeal disease and motor vehicle accidents, also need to be addressed. Military forces contribute to the development of guidelines and policies for delivery of effective health countermeasures associated with deployment of troops.

**REFERENCES**

### Addendum: Military deployment risks in sub-Saharan Africa

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Certain health risks apply universally to military personnel: motor vehicle accidents, heat-related illness, post-traumatic stress disorders, sexually transmitted infections, acute gastroenteritis, etc. Others are more area-specific. This table summarises some important risks, and their prevention, that are particularly associated with deployment in Africa. This is intended to be a brief checklist for planners, not a comprehensive resource: detailed information about these risks can be found in the main article or in standard tropical medicine texts.25-30

<table>
<thead>
<tr>
<th>Risk category</th>
<th>Risk identity</th>
<th>Comments of particular relevance to deployment in sub-Saharan Africa</th>
<th>Risk reduction or prevention strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vector-borne disease</td>
<td>Malaria</td>
<td>Predominantly falciparum malaria; stable transmission in most of west, central and southeast Africa; resistance to chloroquine and pyrimethamine-sulphadoxine is widespread.</td>
<td>Anitmosquito measures; chemoprophylaxis: sometimes field diagnosis and standby treatment may be appropriate – see main article.</td>
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<td></td>
<td>Trypanosomiasis</td>
<td>Currently, resurgence of both west and east African forms of the disease; east African form is much more acute and immediately life-threatening.</td>
<td>Tsetse flies are aggressive daytime biters and little can be done to prevent bites.</td>
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<td>Leishmaniasis</td>
<td>Visceral form in Sudan, Ethiopia, Kenya; cutaneous form in sahelian region and Sudan, and small focus in southern Namibia.</td>
<td>DEET containing repellents; permethrin impregnation of clothes and beds; residual insecticide spraying of limited use.</td>
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<td></td>
<td>Filariasis</td>
<td>Loa loa, onchocerciasis and lymphatic filariasis are all risks in various parts of the region.</td>
<td>Measures to prevent biting flies and mosquitoes (barners, insecticides, repellents, beds, etc).</td>
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<td>Tick bite fever</td>
<td>2 forms of this rickettsial disease are common: boutonneuse fever (usually peri-urban transmission), and African tick bite fever (rural transmission).</td>
<td>Body surface should be checked carefully daily, especially for immature ticks (may be very small); DEET has repellent effect but needs regular re-application.</td>
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<td>Plague</td>
<td>Plague foci currently or recently active in Angola, Namibia, Mozambique, Malawi, Tanzania, Zambia, DR Congo, Uganda, Kenya, Madagascar.</td>
<td>Be alert for rodent die-offs; environmental insecticide application in domestic situation to kill fleas; personal protection: DEET, permethrin will repel fleas; keep living areas hygienic and free of rodent harbourage.</td>
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<td>Tick-borne relapsing fever</td>
<td>Caused by Borella duttoni and related species; transmitted by argasid (soft) ticks eg Ornithodoros moubata.</td>
<td>Avoid sleeping in traditional huts with mud walls or floors, or in caves and animal shelters; insect repellents, beds, doxycycline: as used for malaria prophylaxis.</td>
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<td>Yellow fever</td>
<td>Many central, east, and west African countries (most outbreaks have occurred in west Africa).</td>
<td>Yellow fever vaccine.</td>
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<td>Dengue</td>
<td>Outbreaks in both west and east Africa in last 15 years; US forces in Somalia were affected.</td>
<td>Control peridomestic breeding of main mosquito vector, Aedes aegypti; personal protective measures.</td>
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<td>Other arboviruses</td>
<td>Many agents; common presentation is fever, headache, rash, arthralgia.</td>
<td>Limit exposure to mosquitoes (repellents, coils, screens, beds).</td>
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<td>Haemorrhagic fever syndrome</td>
<td>Viral haemorrhagic fever</td>
<td>Lassa fever (west Africa); Rift Valley fever; Crimean-Congo HF; Marburg HF; Ebola HF.</td>
<td>Lassa: protect food from exposure to rodents; ribavirin for severe Lassa fever; CHF: tick bite prevention; RVF, mosquito bite prevention; avoid slaughter/butchery of sick livestock in epizootics.</td>
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<td>Water-related disease</td>
<td>Schistosomiasis</td>
<td>S. mansoni and S. haematobium are present in most of the area; S. intercalatum in various parts of the region.</td>
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<td>Leptospirosis</td>
<td>Probably an under-diagnosed cause of febrile illness; history of water exposure important.</td>
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<td>Water-borne infection</td>
<td>Hepatitis A and E</td>
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<td>Enteric infection</td>
<td>Typhoid and para-typhoid fevers</td>
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<td></td>
<td>Cholera</td>
<td>Most countries in Africa affected since 1990.</td>
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<td></td>
<td>Poliomyelitis</td>
<td>Recent cases have emerged in west Africa and Angola.</td>
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<td>Blood-borne infection</td>
<td>Hepatitis B, HIV</td>
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<td>Animal-related disease</td>
<td>Trauma from animal attacks</td>
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<td></td>
<td></td>
<td>Brucellosis</td>
<td>Unpasteurised milk of domestic stock is a risk.</td>
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<td>Other infections/ infestations</td>
<td>Meningoococal meningitis</td>
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<td>Myiasis</td>
<td>Furuncular myiasis due to Cordylobia anthropophaga is common throughout the region in animals and humans.</td>
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