CHAPTER 45

Tropical Medicine

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OVERVIEW

- Paramedics are key members of an increasingly mobile global workforce, which are encountering tropical diseases in their practice.
- Tropical medicine is the specialty area addressing the burgeoning load of tropical disease globally. It is increasingly becoming a required part of training in paramedicine.
- A range of tropical diseases, in particular malaria, human immunodeficiency virus and tuberculosis, stand out as major concerns for international operations and deployments, but other common problems, such as arboviral diseases and diarrhoeal disease, also need to be addressed in both a local and an international setting.
- Various national and international groups contribute substantially to tropical disease research and the development of guidelines and policies for delivery of effective countermeasures to infectious and tropical diseases associated with a mobile workforce.

Introduction

With the professionalisation of paramedics as healthcare providers and recognition by health practitioner registration agencies, paramedics are key members of the workforce who, in many cases, are the sole primary healthcare provider in remote areas, and more particularly for offshore mining, petroleum and other facilities and operations. Paramedics are also playing a role at major events, such as the Olympics and Paralympics, as well as having an increasing presence on humanitarian missions. Many of the remote areas in Australia and more particularly abroad carry significantly increased risks of disease outbreaks and exposure to a variety of tropical diseases. It is important to be able to recognise the more common infectious diseases, including important tropical diseases that can be life-threatening.

General approach

While a paramedic working in most Western countries is unlikely to encounter many of the more exotic tropical diseases, there are situations where they can also encounter these conditions among increasingly mobile patients, including the increasing influx of travellers from tropical disease endemic areas. Some of the tropical diseases that might be encountered by paramedics might include malaria, human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) and tuberculosis, as well as a number of other vector-borne and vaccine-preventable diseases. More recently, the emerging infectious disease COVID-19 (a coronavirus, SARS-CoV-2) was also spread through travel and the community required sustained infection control and prevention measures, including wearing of masks (Cheng & Williamson, 2020). One of the most important questions to ask is regarding the patient's travel history, including their itinerary, to gain an understanding of potential exposures to tropical diseases, as well as a history concerning any immunisations or prophylaxis taken. This may open a different range of diagnoses. As always, up-to-date medical reference material and local clinical guidelines should be followed in all cases where immunisations and medical treatment are delivered. When working overseas or in areas with high rates of tropical disease, patient education is a great way to reduce or prevent the acquisition or spread of many diseases. Knowing how a disease is contracted and how it is spread is useful information that can be passed on to the local population.

Guidelines

Comprehensive guidelines in tropical medicine have not been published in a consolidated form; however, various key government, international, non-governmental and commercial organisations have produced a range of relevant publications; these provide guidelines and advice for tropical medicine practice (see Box 45.1). There are also online resources that provide valuable information on disease distribution and prevention (see Box 45.2). *International Travel and Health* (World Health Organization, 2012), produced by the World Health

BOX 45.1 Key guidelines and related resources used in tropical medicine

Guidelines	Scope of coverage
Therapeutic Guidelines: Antibiotic (Antibiotic Expert Group, 2019)	Chemoprophylaxis and treatment guidelines for malaria, travellers' diarrhoea and other tropical diseases
Australian Immunisation Handbook (National Health and Medical Research Council, 2018)	National guidelines on vaccine-preventable diseases, including travellers' vaccinations
Pharmacopoeia, such as *The MIMS Annual* (MIMS Australia, 2018) and similar drug references	Pharmaceutical items for clinical practice and their use
International Travel and Health (WHO, 2012)	Yellow fever areas; general reference on travel-related conditions

BOX 45.2 Major online resources for tropical medicine practice

Name of resource	Internet address
Australian Immunisation Handbook (Australian Technical Advisory Group on Immunisation [ATAGI], 2018)	https://immunisationhandbook.health.gov.au/
International Travel and Health (WHO, 2012)	http://www.who.int/ith
Health Information for International Travel (Yellow Book) (Centers for Disease Control and Prevention, 2020a)	https://wwwnc.cdc.gov/travel/page/yellowbook-home
Communicable Diseases Intelligence (Australian Government Department of Health, 2020)	http://www.health.gov.au/cdi
Weekly Epidemiological Record (WHO, 2020g)	http://www.who.int/wer
Morbidity and Mortality Weekly Report (Centers for Disease Control and Prevention, 2020b)	http://www.cdc.gov/mmwr

Organization (WHO), is designed to assist in determining destinations that might require yellow fever vaccination, in addition to providing broader travel health advice. The WHO provides updates to this publication from time to time (WHO, 2012).

The Centers for Disease Control and Prevention (CDC) also produces a publication, *Health Information for the International Traveler*, which provides similar advice and has some useful maps on yellow fever endemic areas (CDC, 2020a).

CS CASE STUDY 1

Case 180416, 1025 hrs.

Dispatch details: A 38-year-old female presents as a walk-in patient with a skin rash.

Initial presentation: On arrival, the paramedics find the female well, but she presents with curious itchy skin lesions on both feet.

1 ASSESS

History

The patient has returned from a holiday in Koh Samui, Thailand about 10 days previously. The symptoms started a few days after she returned and have worsened. She now presents with what she describes as itchy skin lesions on both feet. She indicates that she had spent most of her time at the beach and around the resort where she was staying.

Closer inspection of the skin lesions on each foot show they are both linear and serpiginous (having a wavy margin). They appeared as tracks on the dorsum of the skin and are quite erythematous. The patient describes the margins as seeming to move around. It looks like worm tracks under the skin.

She is otherwise well with normal observations.

This is typically a spot diagnosis and the condition is called cutaneous larva migrans (CLM) or creeping eruption.

2 CONFIRM

CLM or creeping eruption results from infection with larval stages of animal (dog and cat) or zoonotic hookworms (usually *Ancylostoma* spp.). The history of exposure on a beach where dogs and cats roam free, such as Koh Samui, was important.

Diagnosis of CLM or creeping eruption is generally made on the basis of the typical serpiginous, erythematous tracks that appear in the skin and is associated with intense itchiness and mild swelling. The tracks may spread up to a few centimetres daily. It usually appears 1 to 5 days after skin penetration, but the incubation period may be 1 month or more.

Usual locations are the feet and buttocks, although any skin surface coming into contact with contaminated soil or sand can be affected (the latter in this case). The history of possible exposure is important and in this case it was the beach. There are a lot of stray dogs that inhabit the area around the beaches of Koh Samui and they tend to be heavily infected with hookworms.

What else could it be?

Very rarely, other organisms could cause something similar, such as erythema migrans of Lyme borreliosis, impetigo, scabies, tinea pedis and larva currens. The location on the feet is not typical of larva currens from autoinfection of larval worms of strongyloidiasis. This latter condition is more often seen around the buttocks.

This case study reveals a typical instance of CLM or creeping eruption. As a parasitic worm causes the condition, it is worth understanding the lifecycle of the animal hookworms. The life cycle is given in Figure 45.1 and shows the developing larva penetrating the skin of their animal host. However, in humans the immature larva in animal hookworms tend to not develop any further after penetration of the skin and infect only the skin with subsequent migration of the larvae through the skin, leading to the skin reaction of CLM.

3 TREAT

CLM is not infectious to others, as the immature worms are under the skin and they may or may not be viable. The routine use of gloves by paramedics is sufficient protection. CLM is usually self-limiting, but treatment can alleviate symptoms. Therapeutic options include deworming tablets. These might be either ivermectin (adult and child 15 kg or more) 200 microgram/kg orally with fatty food as a single dose, or albendazole 400 mg (child 10 kg or less: 200 mg) orally with fatty food once daily for 3 days (Antibiotic Expert Group, 2019). The patient can also be reassured that they have been given deworming

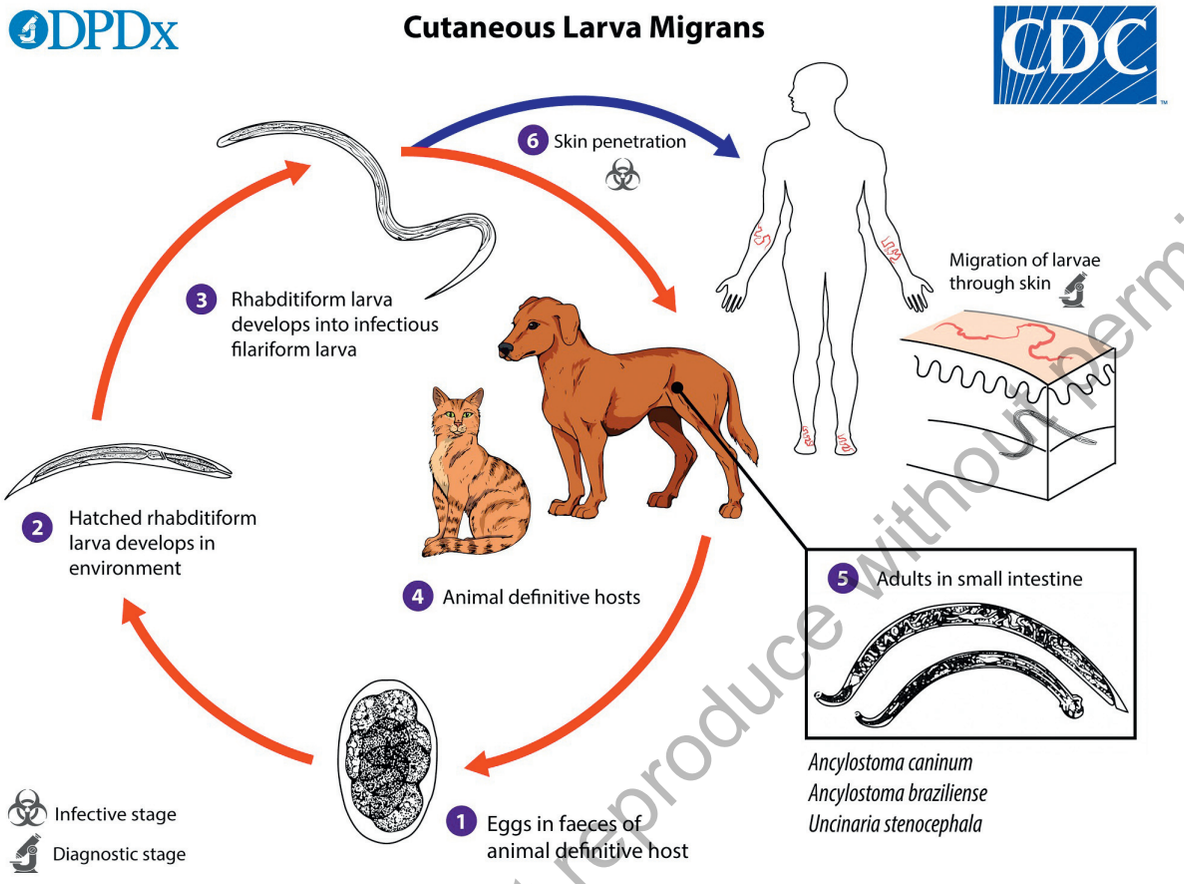

Figure 45.1
Life cycle of cutaneous larva migrans.
Source: Centres for Disease Control and Prevention. https://www.cdc.gov/dpdx/zoonotichookworm/index.html (accessed 19 June 2020).

tablets but that they should return or contact paramedics if symptoms worsen or they get generalised symptoms, such as those that might result from an allergy to the deworming tablet given.

It is important to also look out for secondary bacterial infections, which can result from excessive scratching. Sometimes when the itchiness is intense the patient might need an antihistamine, antipruritic agent, topical anaesthetic or even a sedative. In the case of sedating medications, they may need time off work or restricted duties.

4 EVALUATE

It is important to evaluate the effectiveness of treatment. In this case, the patient should be advised to return in 1–2 weeks. When this patient returns, her condition has cleared almost completely in about 2 weeks, which is typical of CLM. It is important to check for any side effects concerning the medications given. Generally, there are none with the deworming tablets mentioned, but the patient should be advised to return if they are getting drowsy using antihistamines, as they should not operate motor vehicles or machinery if they are affected.

As mentioned previously, it is important to check for evidence of secondary bacterial infections, which can result from the patient's excessive scratching.

Malaria and other vector-borne diseases

Vector-borne diseases remain among the greatest problems for overseas operations in the tropics. Some vector-borne diseases also represent a potential public health problem when personnel return home. Malaria (see Box 45.3) remains the single most important vector-borne disease problem for overseas deployments; however, arboviral diseases such as dengue and Japanese encephalitis (see Box 45.4) are becoming important health problems during deployment. Some vector-borne diseases are important for operations within Australia as well as international deployments (e.g. scrub typhus, which affected personnel in northern Australia and the South-East Asian region; McBride et al., 1999). Other vector-borne diseases, such as lymphatic filariasis (see Box 45.5), pose some concerns for operations in the Asia–Pacific region, where the disease is endemic.

Many infectious diseases of travellers can be prevented by immunisation. There are few mandatory vaccines for which certification is necessary; these include yellow fever and meningococcal meningitis, which is prescribed by the WHO (2012), when travelling to/from certain countries. In addition to routine and national schedule vaccinations, specific vaccinations may be required for particular destinations. It seems prudent to vaccinate against diseases that might be acquired through food and water, such as hepatitis A, typhoid and polio

BOX 45.3 Malaria

The WHO estimates that there are more than 216 million cases of malaria and 445,000 deaths due to malaria worldwide each year (WHO, 2020c). Most serious cases and deaths are due to infection with *Plasmodium falciparum*; however, *P. vivax* infection remains important, especially as dormant liver stages can cause relapses for months. Other species include the much less common *P. ovale* (can also cause relapses), *P. malariae* and *P. knowlesi* (a potentially deadly 'monkey malaria' emerging in South-East Asia) (WHO, 2020c). Malaria is transmitted by *Anopheles* sp. mosquitoes, which generally bite at night.

Malaria countermeasures include chemoprophylaxis, personal protective measures against mosquito bites (PPMs), environmental health measures against disease vectors and eradication treatment for parasite liver stages on return to Australia. Current recommended chemoprophylaxis includes doxycycline, mefloquine and Malarone (atovaquone plus proguanil) (Antibiotic Expert Group, 2019). Current eradication treatment for malaria is primaquine, although tafenoquine (a longer half-life primaquine analogue) has recently been approved in Australia and other jurisdictions (Therapeutic Goods Administration, 2018).

Because of the possible associated incidence of neuropsychiatric effects, such as anxiety and nightmares, patients should be screened for conditions that might preclude the use of mefloquine (Antibiotic Expert Group, 2019). Trial doses should be considered, possibly commencing as early as 2–3 weeks before departure (Ingram & Ellis-Pegler, 1997). It is also advisable that patients be given trial doses of other antimalarial agents that they are taking for the first time, such as doxycycline and Malarone (atovaquone/proguanil). This allows time to consider alternative drugs if necessary (Antibiotic Expert Group, 2019).

Opinions vary on how long antimalarial agents should be continued after leaving a malaria area. For drugs that have no pre-erythrocytic effects on the liver stages of the parasite, such as doxycycline and mefloquine, drugs should be continued for up to 4 weeks. This relates to the time it takes for residual parasites to develop in the liver and infect the bloodstream. Malarone, which has some effects on the hepatic stages of *P. falciparum*, may be given for shorter periods (1 week) after return (Antibiotic Expert Group, 2019).

For more remote areas, standby treatment may be useful. This consists of a course of drugs that travellers to malaria endemic areas can use for self-treatment if they cannot obtain medical advice within 24 hours of becoming unwell (Antibiotic Expert Group, 2019). A medical kit may be supplied with a thermometer, possibly an immunochromatographic test (ICT) malaria diagnostic kit and written instructions, an appropriate malaria treatment course and written instructions. Medical advice should be sought as soon as possible. Drugs that may be useful for standby treatment include Malarone and Riamet (20 mg artemether and 120 mg lumefantrine) (Antibiotic Expert Group, 2019). Malarone should not be used for standby treatment, if also used for chemoprophylaxis. Treatment of malaria is detailed elsewhere (Antibiotic Expert Group, 2019; WHO, 2015).

BOX 45.4 Arboviral diseases

Many arboviral diseases may be encountered in Australia and the region. Two of the most important arboviruses in the region are dengue and Japanese encephalitis, as they are prevalent in South-East Asia. Both diseases are transmitted by various species of mosquitoes, some of which exist in Australia, especially in north Queensland. Others of recent concern include Zika and chikungunya.

Dengue

The WHO estimates that there are more than 96 million clinical cases of dengue per year (WHO, 2020a). It is a viral illness, and infection may range from subclinical to fever, arthralgia and rash, or be complicated by haemorrhagic diatheses or shock syndromes (severe dengue). Severe dengue may be more common in those becoming infected with a subsequent infection with a different serotype of dengue (there are four serotypes, 1–4) (WHO, 2020a). It is spread throughout the tropical regions of the world, especially in urban areas. The vector is mosquito, generally *Aedes aegypti* or *Aedes albopictus* (WHO, 2020a). Treatment is supportive, and management of the problem is directed towards preventing transmission upon return to Australia. Outbreaks of dengue in north Queensland have been attributed to travellers returning with the disease. A study of soldiers returning from East Timor during the incubation period of the disease showed that a collaborative effort by military and civilian public health authorities to contain and prevent the transmission of the disease is vital (Kitchener et al., 2002). Although a dengue vaccine is available, it provides limited protection for workers and travellers abroad and prevention still depends on personal protective measures (PPMs) and environmental health measures against disease vectors (WHO, 2020a). The vaccine has been registered in a number of countries to assist in the public health control of dengue.

Japanese encephalitis

Japanese encephalitis (JE) is a flavivirus (same group as dengue and yellow fever) and is the leading cause of viral encephalitis in Asia. The WHO estimates that there are more than 68,000 cases annually in South-East Asia (WHO, 2019b). Up to a third of patients with clinical disease die and about half have permanent residual neurological sequelae (WHO, 2019b). Several effective vaccinations are available (WHO, 2019b).

Zika

Zika is a flavivirus (same group as dengue and yellow fever) that is transmitted by the *Aedes aegypti* mosquito (WHO, 2018). Symptoms are generally mild and include fever, rash, conjunctivitis, muscle and joint pain, malaise or headache. Symptoms typically last for 2–7 days. This arbovirus came to prominence through a finding of increased microencephaly in South American outbreaks. The WHO has now determined that there is a causative link between Zika and microcephaly and also Guillain-Barré syndrome (WHO, 2018). The WHO has provided advice for those women who are pregnant and intending to become pregnant (WHO, 2018). There is no vaccine. PPMs remain the first line of defence in endemic areas.

Chikungunya

Chikungunya is an alphaviral disease (same group as Ross River Virus) transmitted to humans by infected mosquitoes. It causes fever and severe joint pain. Other symptoms include muscle pain, headache, nausea, fatigue and rash (WHO, 2017). Joint pain is often debilitating and can vary in duration. Mosquitoes involved in transmission include *Aedes aegypti* and *Aedes albopictus*. The disease shares some clinical signs with dengue and Zika, and can be misdiagnosed in areas where they are common (WHO, 2017). There is no vaccine. PPMs remain the first line of defence in endemic areas.

(Australian Technical Advisory Group on Immunisation [ATAGI], 2018), as well as using other measures to combat these diseases. The most common vaccine-preventable disease is hepatitis A (ATAGI, 2018); typhoid vaccination should also be considered for travel to many developing countries. Polio vaccination is rarely required these days, but may be required in situations where polio outbreaks have been reported (ATAGI, 2018).

Other infectious diseases, such as hepatitis B, Japanese encephalitis and rabies, are also vaccine preventable. The development of combination vaccines, such as hepatitis A plus typhoid and hepatitis A plus B, has greatly reduced the number of injections required (ATAGI, 2018). The development of rapid schedules for those departing at short notice has been useful in providing protection within 4 weeks (ATAGI, 2018).

Other tropical diseases, such as leptospirosis and rickettsial diseases, are not vaccine preventable and may affect workers and travellers in rural areas of Australia and overseas. Prevention of diseases may

BOX 45.5 Lymphatic filariasis

Lymphatic filariasis is the second most common vector-borne disease, after malaria. It is caused by three species of nematode parasites, which can be spread by a wide range of mosquito species. The WHO estimated the global burden of infection to be 120 million, with nearly 900 million people at risk of infection (WHO, 2020b). Lymphatic filariasis is also the second most common cause of long-term disability with about 40 million disfigured or incapacitated from the disease (WHO, 2020b). It has a widespread geographic distribution, mainly in tropical regions, including most of Australia's neighbouring countries in the tropics. Given its widespread distribution and the increase in mining and other operations in filarial-endemic areas, steps should be taken to prevent transmission of lymphatic filariasis among personnel, which mainly relate to PPMs. There is no vaccine. Treatment is described elsewhere (WHO, 2020b).

require the use of personal protective measures by personnel and in some cases chemoprophylaxis with doxycycline (Antibiotic Expert Group, 2019).

Tuberculosis

Tuberculosis (TB) is caused by a bacterial infection with *Mycobacterium tuberculosis* and a number of non-human mycobacterial species. There are about 10 million people who fall ill each year from TB and about 1.6 million people who die (WHO, 2020f). It can lie dormant in people for many years. Spread is through aerosols and the main presentation is pulmonary TB, but it can present as an extra-pulmonary infection (WHO, 2020f). At-risk groups for infection include those who have had close contact with an infected person, immigrants from places with high rates of TB, various other groups of people with increased transmission rates and people who work closely with groups of people that have an increased transmission rate (e.g. healthcare workers).

Common signs and symptoms of pulmonary TB include a cough persisting for over 3 weeks, which may be productive (blood or sputum), and may be associated with chest pain, weakness, fatigue and weight loss (often due to loss of appetite). Often, the patient will have a fever, accompanied by chills and night sweats. Extra-pulmonary TB symptoms depend on the organs or system affected. Screening tests are available. For healthcare workers, the use of personal protective equipment (PPE) or respiratory devices is recommended such as a properly fitting N95 mask. TB screening should be considered before deployment abroad and upon return. Treatment regimens are prescribed by the WHO and by Australian guidelines. Although TB vaccination exists, it is not useful in adult population (WHO, 2020f).

Human immunodeficiency virus

Human immunodeficiency virus (HIV) is a retrovirus that attacks the patient's immune system, specifically CD4 T-cells, weakening the body's ability to respond to infections and some cancer. As the infection continues to destroy and impair immune function, individuals become immunodeficient (WHO, 2019a). If HIV is left untreated, it leads to the development of acquired immunodeficiency syndrome (AIDS), the most advanced stage of HIV infection, defined by the development of infections and some cancers. Once infected with HIV, individuals carry it for life.

The WHO estimates that there are 36.9 million people living with HIV and there are around 1.8 million new cases annually. There are nearly 1 million HIV deaths annually. There is no cure for HIV infection and there is no vaccine. However, effective antiretroviral (ARV) drugs can control the virus and help prevent transmission so that people with HIV, and those at substantial risk, can enjoy healthy, long and productive lives (WHO, 2019a). Post-exposure prophylaxis is also available.

Other tropical and emerging diseases

Many other tropical diseases exist in different countries. Many of these are considered neglected tropical diseases (NTDs) (see Box 45.6). For many of these NTDs, there tends to be need for better treatments, such as Leishmaniasis and Trypanosomiasis (WHO, 2020d).

Future research

Despite the significant scientific advances in tropical medicine in the 20th and early part of the 21st century, much needs to be done to combat traditional and emerging communicable diseases as well as the emerging non-communicable disease burden in developing countries. In addition to the longstanding excellence of work coordinated by international agencies, such as the WHO's Special Program for Research and Training (WHO, 2020e), governments, commercial interests (such as pharmaceutical companies), and non-government organisations (such as the Gates

BOX 45.6 Neglected tropical diseases

- Buruli ulcer
- Chagas disease
- Dengue and Chikungunya
- Dracunculiasis (guinea-worm disease)
- Echinococcosis
- Foodborne trematodiases
- Human African trypanosomiasis (sleeping sickness)
- Leishmaniasis
- Leprosy (Hansen's disease)
- Lymphatic filariasis
- Mycetoma, chromoblastomycosis and other deep mycoses
- Onchocerciasis (river blindness)
- Rabies
- Scabies and other ectoparasites
- Schistosomiasis
- Soil-transmitted helminthiases
- Snake-bite envenoming
- Taeniasis/cysticercosis
- Trachoma
- Yaws (endemic treponematoses)

Source: WHO (2020d)

Foundation) have joined the fight against health problems in the tropics. Countries in the region, including Australia, remain in the forefront of tropical disease research. This augurs well for development of tropical medicine in Australasia and the potential elimination of some tropical diseases in the 21st century.

Summary

Tropical diseases may be encountered in paramedicine, particularly through overseas deployment. They may be encountered by workers and travellers abroad to countries with endemic tropical diseases and may present in workers, travellers and migrants entering Australia. Australia has a relatively long tradition of academic courses in tropical medicine, with programs continuing today in tropical medicine and its applications such as travel medicine and international public health. A professional organisation in tropical medicine, the Australasian College of Tropical Medicine (ACTM), has been established for Australasia with similar bodies in other countries. The ACTM maintains a body of knowledge in tropical medicine relevant for the region. With enhanced prospects for academic training, professional recognition and development, as well as research, perhaps we are entering a new golden age in tropical medicine.

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