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Vaccines for travel – an update

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Key words

Travel medicine, vaccination, infectious diseases, review article

Abstract

(Batchelor T. Vaccines for travel – an update. *SPUMS J* 2003; 33: 149-156) Many vaccine-preventable diseases that have been eradicated from developed nations remain a significant health problem in the less developed countries of the world. Making reasoned vaccination recommendations to a traveller requires a sound knowledge of the epidemiology of the diseases in the destination country and should take into account individual factors such as length of trip, specific activities, underlying health conditions and style of trip. As a guideline, vaccines can be categorised as either 'routine', 'required' or 'recommended'. It is important that travellers and their advising doctors are not lulled into a false sense of security that all health problems related to travel will be prevented by undertaking a vaccination programme before travelling.

Introduction

Many vaccine-preventable diseases are but textbook entities for young doctors working in the developed world today. Unfortunately, this is not yet the case in many of the world's developing nations. When travellers from the developed world visit less developed countries they are potentially exposed to many pathogens to which they are immunologically naive. Vaccinations provide important protection against a number of serious illnesses still prevalent in many parts of the world.

Making decisions about vaccine recommendations for an individual traveller requires the consideration of a number of factors, including the individual's health status; season of travel; style of travel; duration of travel; activities; cost issues and the individual's attitude to risk. Cost-benefit analysis of travel vaccines on a community basis shows that the cost of preventing travel-related disease is high e.g., US\$30,000 to prevent one case of hepatitis A.¹ In countries such as Australia and New Zealand it is up to the individual to decide if they are prepared to pay in order to prevent or limit their risk of contracting various diseases.

In view of the potentially high cost to the individual it is imperative that recommendations are based on a sound knowledge of the epidemiology of the disease in the destination country and a reasoned analysis of the risk and benefit for each individual. The rational prescription of vaccines will balance risk, benefit and cost to provide individual recommendations. There is a risk that undertaking a pre-travel vaccination programme will induce complacency and the traveller must be aware that vaccines will not protect them against the most common of travellers' illnesses – diarrhoea, respiratory infections (other than influenza and pneumococcal pneumonia), altitude-related problems, injuries and skin infections.

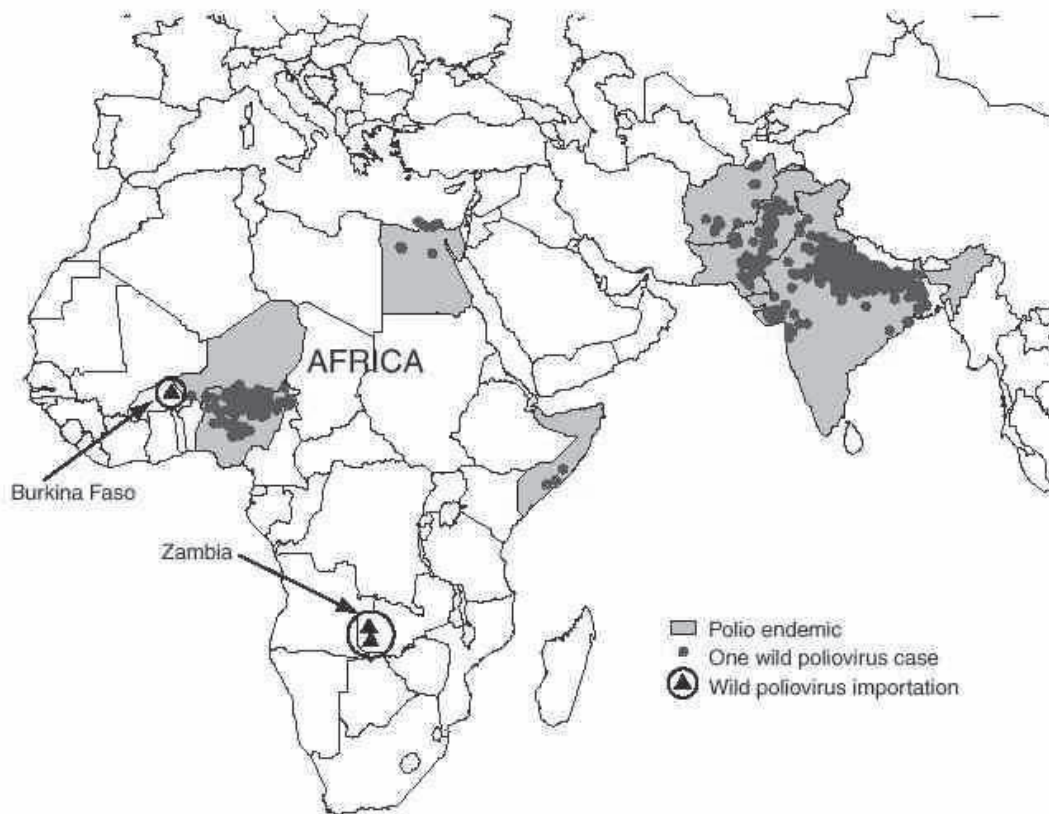
Routine vaccinations

Travel is an excellent opportunity to review the status of an individual's routine vaccinations. The anti-vaccination movement is relatively strong in Australia and New Zealand. Practitioners will not uncommonly be faced with parents planning a trip to a less developed country with completely unimmunised children. This requires great tact and excellent communication skills. With an explanation of the concept of herd immunity and the lack thereof in less developed countries, many parents will reconsider their stance and opt to have their children vaccinated against at least some vaccine-preventable diseases. The availability of inactivated polio vaccine and acellular pertussis vaccine has been helpful in allaying the fears of side effects related to the older versions of these two vaccines. In an ideal world no parent would take their unvaccinated child to a less developed country. After a non-judgemental and information-sharing consultation, it is hoped many parents will understand the different level of risk involved in travel as opposed to being safely at home.

POLIOMYELITIS

There are three different strains of the polio virus capable of causing disease. The virus, which principally affects motor and autonomic neurones, is spread via both the faecal-oral and respiratory routes. Infection can vary from inapparent to severe paralysis and death. In 1988 the Assembly of the World Health Organization (WHO) resolved to eradicate polio from the world by the year 2000. Whilst this goal has not yet been achieved, significant progress has been made and as of 2003 fewer than 10 countries are still reporting polio (Figure 1).² The National Health and Medical Research Council (NHMRC) of Australia continues to recommend a booster of oral polio vaccine (OPV) to all travellers. However, authorities such

FIGURE 1. LOCATION OF LABORATORY-CONFIRMED POLIOMYELITIS IN COUNTRIES WHERE POLIO IS ENDEMIC, 2002 (as of 9 April 2003; from ref 2)



as WHO and the Centers for Disease Control (CDC) recommend boosters only for those travellers who are visiting endemic countries and who have not previously received a single adult booster.

National guidelines differ regarding the use of OPV in preference to inactivated polio vaccine (IPV). There is a small risk of vaccine-associated paralysis after the administration of OPV. Countries such as the United States and New Zealand now routinely administer IPV for at least the first two of the childhood series of polio vaccinations in order to decrease the risk of this complication. The risk of paralysis reduces significantly with subsequent doses of OPV and in a previously vaccinated adult recipient is estimated to be between 1 in 2.5 million and 1 in 5 million.^{3,4} Travellers should be warned of this small risk of paralysis and be offered the choice of OPV or IPV in countries where both options are available. If the traveller has no past history of vaccination they should receive a primary course of IPV.

TETANUS, DIPHTHERIA AND PERTUSSIS

This vaccine combining adult diphtheria and tetanus (ADT) should be administered if the traveller has not had a booster within the last 10 years. Current recommendations within Australia are for a course of five injections before the age of 19 and then a single booster at the age of 50. Travellers are, however, still recommended to have had a booster within the previous 10 years, primarily to avoid the necessity

of making contact with the local healthcare system should they sustain a minor, but still potentially tetanus-prone, wound. *Clostridium tetani*, the causative organism of tetanus, remains ubiquitous throughout the world. Cases are still reported even in the industrialised world in unvaccinated children and older adults with waning immunity. A 1993 survey in Sydney showed only 52% of adults aged over 50 had adequate tetanus antibody titres.⁵

A new vaccine combining ADT and acellular pertussis (Boostrix) is now available in Australia and New Zealand. Pertussis remains a significant problem throughout the world as immunity acquired from childhood vaccination wanes in early adult life. Children under the age of six months who have not yet completed their primary vaccination schedule are at the highest risk of severe disease. There is evidence that adults carrying the disease can be important sources of transmission to this susceptible group.⁶

Unfortunately, the duration of immunity provided by the pertussis component of Boostrix is short (2–5 years) compared with the protection provided by the other components of the vaccine. It is therefore difficult to identify the ideal timing for administration of the vaccine. Theoretically, the ideal time to administer Boostrix would be during pregnancy, as this would help reduce the pool of adults who could potentially infect very young, unvaccinated children. However, there are inadequate safety data on the vaccine in pregnancy. Others have suggested that

administration in late adolescence would be most appropriate.⁷ Currently, it is recommended for healthcare workers in close contact with young children and those considering childbearing who require an ADT booster. Medical aid workers should also be offered this vaccine.

MEASLES, MUMPS AND RUBELLA

Measles-mumps-rubella vaccination (MMR) is often overlooked in the pre-travel consultation. Of particular concern is measles, a paramyxovirus, easily spread via respiratory droplets. Complications of measles include acute encephalitis (2–10/10,000 cases) and delayed subacute sclerosing panencephalitis (1/25,000 cases). In the years between 1976 and 1995 measles caused more deaths in Australia than diphtheria, tetanus, pertussis and polio combined,⁸ and the disease remains common in many developing countries. Outbreaks in Australia have been linked to travellers. A booster of MMR is recommended to all travellers born after 1966 who do not have evidence of having had two vaccines in the past.

VARICELLA

Varicella vaccine was licensed for general use in the US in 1995 and by 1996 the CDC had recommended that all healthy individuals over the age of one with no history of the disease should be immunised. Varicella vaccine is not funded in Australia and New Zealand despite its administration being recommended as 'best practice'. Pending new guidelines for varicella in Australia include a routine vaccination to children at the age of 18 months, with a catch-up dose between the ages of 10 and 13 for those previously unimmunised. Over the age of 14, two vaccines administered at least six weeks apart are required.

The uptake of varicella vaccine has not been adequate and this is most likely based on the perception that varicella is a mild disease. Whilst this is true of the majority of cases, complications such as pneumonia, encephalitis, cerebellar ataxia and necrotising fasciitis do occur. Congenital varicella can cause a severe syndrome resulting in skin, eye, limb and brain damage.⁹ In Australia there are 240,000 cases of varicella resulting in 1,200 hospitalisations and an average of 4.2 deaths annually.¹⁰

A remembered history of chickenpox correlates highly with positive serology. Those who have no recall of the disease should be offered serology and, if negative, recommended vaccination. As a live vaccine, it is contra-indicated in pregnancy and the immunocompromised.

INFLUENZA

The pre-travel consultation is an excellent opportunity to ensure that high-risk individuals have received the current influenza vaccine. Influenza is a common disease in travellers and any traveller who wishes to reduce their risk of infection should receive the vaccine. The outbreak of

severe acute respiratory syndrome (SARS) this year provides another good reason to vaccinate; as the symptoms of influenza are indistinguishable from SARS, reducing the chance of contracting influenza will also reduce the risk of being assessed as a potential SARS patient. Large outbreaks of influenza have occurred on cruise ships and at other large gatherings.¹¹ Cruise-ship passengers can also be responsible for introducing influenza into host countries; for example, Vanuatu suffered a large flu outbreak two years ago due to infected cruise-ship visitors.

Each year, in October, the WHO releases the composition of the flu vaccine for the approaching northern-hemisphere winter. In most years the southern-hemisphere vaccine has offered adequate protection; however, this should be confirmed annually.

PNEUMONIA

Pneumococcal vaccine (23-valent) is a routine vaccination for individuals over the age of 65, asplenic individuals and the immunosuppressed. It is expected that the updated version of the Australian Immunisation Guidelines will also recommend pneumococcal vaccine to smokers. Again, the pre-travel consultation is a good opportunity to ensure at-risk individuals are up to date. Pneumonia is a common cause of morbidity in elderly travellers. The new conjugated vaccine (Pneumovax) may be appropriate for young children in expatriate families going to live in developing countries.

HEPATITIS B

Childhood immunisation against hepatitis B is slowly becoming routine throughout the world. In relation to travellers, the WHO states,

"the vaccine should be considered for virtually all travellers to highly endemic areas".¹²

The hepatitis B virus is transmitted from person to person via the body fluids of an infected individual. Potential exposures for travellers include sexual contact; medical intervention using unsterile equipment (injections, dental work etc.); skin-perforating cosmetic procedures (tattooing, piercing, etc.); helping an injured person who is bleeding; accidents during sporting activities; and sharing personal items such as razors. A recent survey of 9,000 British travellers showed that approximately 10% of travellers had received high-risk exposures to the virus and approximately 70% had potential exposures whilst abroad. Only 16.9% of these travellers had been vaccinated against hepatitis B.¹³ The incidence rate of hepatitis B in travellers has been estimated at 60/100,000 per month for symptomatic disease and 360/100,000 for asymptomatic disease in Asia. In Latin America and Africa the incidence has been estimated at 20/100,000 for symptomatic and 60/100,000 for asymptomatic disease.¹⁴ In one region of the United Kingdom, travellers accounted for 12% of reported cases between 1990 and 1994.¹⁵ It is estimated that there are 350 million carriers worldwide, with carriage rates as high as

15% in some Asian and central-African countries.

The incubation period of hepatitis B is 45 to 180 days and the period of infectivity extends from some weeks prior to the development of symptoms until the end of the acute illness. Acute illness is indistinguishable from other forms of hepatitis. After the acute infection between 1% and 12% of adults will become carriers or develop chronic infection. If the disease is acquired in the neonatal period this rate approaches 90%. Chronic active hepatitis develops in over 25% of carriers and some 15–25% of these individuals will develop hepatocellular carcinoma or cirrhosis.

The standard vaccination schedule for adults is three injections administered at 0, 1 and 6 months. If protection against hepatitis A is also required, the combined vaccine (Twinrix) can be utilised. A rapid schedule is also approved and this comprises three injections at Day 0, 7 and 21 with a booster at one year. This schedule is valuable if the traveller has less than one month until their departure, or they are likely to be lost to the six-month follow-up vaccination recall. There is good evidence that individuals who respond adequately to the primary vaccination series do not require booster doses.¹⁶

Current NHMRC guidelines for hepatitis B vaccination recommend boosters for those at high risk of exposure e.g., healthcare workers, or immunocompromised individuals. In these individuals, booster doses should be given when antibody titres drop below protective levels. Routine antibody testing after vaccination is not recommended by most authorities but it may be considered on an individual basis. Those who are at higher risk of not seroconverting (e.g., the immunosuppressed) or at high risk of exposure should be offered serology six to 12 weeks post-vaccination. Non-responders should be investigated for carriage status and if negative can receive three more vaccines at one- to two-month intervals. There is no value in administering more than six doses of the vaccine to non-responders.

Vaccines recommended to all travellers to areas with less than adequate food and water hygiene

HEPATITIS A

Hepatitis A virus is spread via contaminated food and water and remains highly endemic in many developing countries. In non-immune travellers the risk of contracting the disease varies from 3/1,000 per month in low-risk travellers (urban and resort-style travel) to 20/1,000 per month in those who are more 'off the beaten track'.¹⁷

The incubation period of hepatitis A is 15–50 days and infectivity is highest from the latter part of the incubation period until several days after the onset of jaundice. Symptoms are indistinguishable from other forms of hepatitis – fever, malaise, nausea, right upper quadrant pain and the onset of jaundice. There is no specific treatment available for hepatitis A, and fulminant hepatitis occurs in

3–4% of infected individuals over the age of 40. The disease is usually asymptomatic or very mild in young children, but increases in severity with increasing age.

Several inactivated vaccines are available on the world market, offering comparable levels of protection. If required, they can be interchanged for booster immunisations. The standard schedule is two injections at an interval of six to 12 months. Strong amnestic responses to delayed boosters have been proven. Therefore, there is no need to recommence the course of vaccination even if several years have elapsed since the initial vaccine was administered.

There are no clear guidelines on the timing of booster doses, with mathematical models predicting protective antibodies for over 25 years. Antibody testing post-vaccination is not recommended as seroconversion rates approach 100%, except in the immunocompromised. Some individuals, however, may benefit from pre-vaccination antibody testing in order to avoid the cost of this expensive vaccine. Such individuals include those who grew up in an endemic country, those with a history of childhood jaundice, and travellers over 60 years of age, as they are more likely to have been previously infected and will therefore have lifelong immunity. If time permits they should be offered antibody testing prior to vaccination.

TYPHOID

Typhoid fever, otherwise known as enteric fever, is transmitted by the bacterium *Salmonella typhi*. This food- and water-borne disease remains common throughout the developing world. The annual incidence is estimated at over 16 million cases, resulting in 600,000 deaths. Countries noted to be of particular risk to travellers include India, Nepal, Peru and Indonesia. Immigrants returning to their home countries to visit family and friends are at particular risk of typhoid as they often presume they have immunity and eat and drink without taking any special precautions.

After an incubation period of one to two weeks, typhoid presents as a slowly rising fever accompanied by headache, malaise and sometimes non-productive cough. Varying degrees of abdominal pain, diarrhoea or constipation may be present. As the disease progresses the patient looks increasingly toxic, and without treatment the case fatality rate approaches 10%. Of great concern is the increasing level of quinolone-resistant typhoid being reported, particularly in India and Nepal.¹⁸

All travellers to countries with poor food- and water-hygiene standards should be vaccinated. There are two vaccines currently available – the Vi polysaccharide injection and the Ty21a oral capsules. The injectable Vi vaccine is generally preferred as patient compliance with the capsules is notoriously poor. The injectable vaccine provides around 70% protection for two to three years. If travel to a highly endemic country is undertaken more than two years after vaccination a booster is recommended. Neither of these

vaccines protect against paratyphoid.

Compulsory vaccines

YELLOW FEVER

Yellow fever is a flavivirus transmitted by mosquitoes, with a distribution limited to the African continent and parts of South America. Outbreaks of yellow fever have increased in frequency and severity over the past 20 years and the WHO estimates that around 300,000 infections, resulting in 20,000 deaths, occur in endemic areas every year. Travellers are required to show proof of vaccination within the last 10 years when entering most countries within the endemic zone, and may be required to show proof when entering non-infected countries within six days of visiting a country in the endemic zone. The vaccination can only be administered at WHO-approved vaccination centres, and these centres should carefully examine an individual's itinerary to determine if the vaccine is required.

The yellow fever virus causes a biphasic illness. Initially, general symptoms of fever, myalgias, chills, anorexia and nausea dominate. About 15% of patients progress to a second phase after a few days, characterised by resurgence of fever, jaundice, abdominal pain and haemorrhagic manifestations. The mortality rate in this group of patients is around 50%.

In recent years, concern has been raised over the potential adverse effects of the yellow fever vaccine. The CDC

published a report that highlighted an association between severe adverse events and age over 75.¹⁹ Elderly travellers should be warned of the potential risk of the vaccine and it should only be administered if the risk of being exposed to the virus outweighs the risk associated with the vaccine. For most travellers, however, the risk of severe adverse events is extremely low, and it should be administered if travel is to be undertaken to an endemic area.

Yellow fever vaccine is a single injection and provides at least 10 years' protection. It is a live vaccine and is therefore contra-indicated in pregnant women (unless they are at significant risk), the immunosuppressed, those with egg allergies and children under the age of nine months.

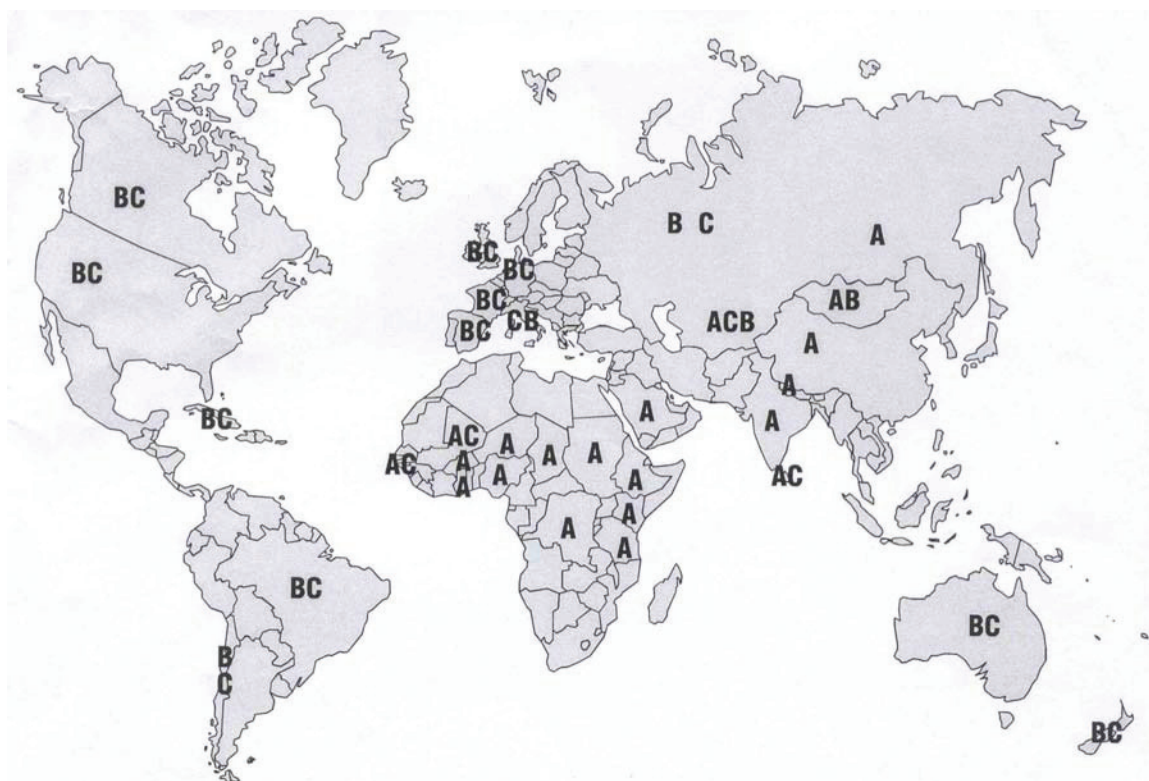
Vaccines recommended for long-term travellers or those undertaking specific activities

MENINGITIS

There are at least 13 serotypes of *Neisseria meningitidis*; however, more than 90% of clinical disease worldwide is caused by groups A, B and C (Figure 2).²⁰ Meningococcal disease is spread via aerosol drops or secretions. Invasive disease remains a medical emergency, with case fatality rates at around 10% even in developed countries.

A recent case-control study in the US showed a number of factors to be associated with an increased risk of invasive disease: active and passive smoking; recent respiratory illness; corticosteroid use; new residence; new school; and

FIGURE 2. Distribution of predominant *N. meningitidis* serogroups (A, B, C), 1996-1997²⁰



household crowding.²¹ Other studies have identified certain behaviours as risk factors during outbreaks: smoking; visits to crowded, poorly ventilated bars; and intimate kissing.²²

It is difficult to give clear guidelines on who should be vaccinated against meningitis, as the disease rate in travellers is extremely low. When assessing an individual's risk, factors that should be taken into account include their destination, the nature and duration of their exposure, the age of the traveller and the state of their underlying health. However, all travellers to the 'meningitis belt' in sub-Saharan Africa should be vaccinated, as should visitors to any countries with increased disease activity.

According to the WHO,

"higher risk exists for long-term travellers and those who will be in close contact with the local population through accommodation, public transport and work".²³

Those at greatest risk are children under the age of five years, with a secondary peak occurring in the 15–24 age group. Asplenic travellers should also be vaccinated.

One should be aware of the worldwide distribution of serotypes if one is to prescribe rationally (Figure 2).²² Serogroup A is most commonly implicated in endemic and epidemic disease in Africa; groups A and C predominate in Asia; and groups B and C predominate in most of the developed world. Thus, vaccinating a traveller to sub-Saharan Africa with group C vaccine is clearly inappropriate.

JAPANESE B ENCEPHALITIS

Japanese b encephalitis (JBE) is caused by a flavivirus transmitted by *Culex sp.* mosquitoes, which breed in rural areas, particularly rice paddies, and are outdoor, night-time feeders. The disease was previously only found in Asia; however, it has now spread as far west as Papua New Guinea, and as far south as Cape York. There are two broad epidemiological patterns. In the more temperate northern parts of Asia, such as Nepal, northern India and Japan, the disease occurs in epidemics during the warmer summer months, generally May to October. In more southern tropical areas, cases occur sporadically throughout the year with a peak early in the rainy season.

JBE is common in the local Asian population. Serological surveys have shown that in endemic areas the majority of the population have been infected by early adulthood. However, only between 1 in 250 and 1 in 1,000 of infected persons develop clinical disease. This still results in over 50,000 clinical cases reported annually.

JBE remains a rare disease in travellers. The CDC reviewed cases of JBE in travellers in 1993 and concluded that the overall risk to travellers was in the order of one per million per week. This estimate, however, included a denominator

dominated by short-term travellers to low-risk areas. When trying to estimate a risk for travellers to high-risk areas during a high-risk season they provided a rough estimate of between 1 in 5,000 and 1 in 20,000 per week.²⁴ Whilst JBE is rare, it is a very serious disease, with a 30% mortality rate and around 50% of survivors suffering permanent neurological sequelae. There is no specific treatment.

Vaccination involves administering a series of three injections of the Biken vaccine at Day 0, 7 and 30. If there is limited time it can also be given as an accelerated schedule at Day 0, 7 and 14. Both regimens result in almost 100% seroconversion, but a lower antibody titre is reached with the rapid schedule. The optimal timing of booster doses has not been adequately studied and current recommendations are to boost after two to three years if exposure continues.

Concerns have been raised over the incidence of adverse events following administration of this vaccine. Millions of doses had been administered in Asia without apparent problems before it was used extensively in travellers. In the early 1990s a number of severe adverse reactions were reported from Denmark, Australia and Canada. These included angio-oedema and urticaria that often occurred some days after the administration of the vaccine. Since then, such reactions have occurred only sporadically, and three batches of vaccine were linked to the markedly increased rate of adverse events during that period.

Anaphylaxis has never been reported to occur after the administration of the Biken vaccine. Further, detailed surveillance since the early 1990s has shown that the rate of adverse events due to the vaccine is no different to the rates reported for many other vaccines.²⁵ In view of the small possibility of a delayed hypersensitivity reaction it is still advised that travellers have access to medical care for the ten days following vaccination.

Vaccination is recommended for the following groups:

- expatriates living in endemic countries;
- travellers spending time in rural areas during the transmission season, particularly in rice-growing areas;
- backpackers and cyclists who are doing long trips with uncertain itineraries;
- military personnel in endemic areas;
- long-term workers or visitors to rural areas visiting during the transmission season.

The recommendations of the WHO and CDC are rather open and suggest vaccination for those spending more than two weeks in rural areas during the transmission season.

RABIES

Rabies virus is serotype 1 of 7 serotypes of the genus *Lyssavirus*. It is transmitted by the bite, scratch or lick of an infected animal. The disease remains a major public health problem in much of the developing world, with over

50,000 deaths occurring annually, at least half of which occur in India. Millions of post-exposure treatment doses are given annually. The risk of a traveller developing rabies is low; however, the risk of being bitten by a potentially rabid animal is relatively high, 1 in 1,000 travellers per month in one epidemiological study.²⁶ In terms of vaccine-preventable diseases this risk was exceeded only by the risk of contracting hepatitis A. However, rabies pre-exposure vaccination is often neglected in the pre-travel consultation.

Rabies causes an invariably fatal encephalitis. The incubation period ranges from 20–90 days, although incubation periods of many years have been recorded. The initial symptoms of rabies are non-specific and last around 10 days before encephalitis intervenes. At this stage symptoms such as aerophobia, hydrophobia, disorientation, and hyperactivity develop and are accompanied by signs of autonomic instability such as hyperventilation, hypersalivation and hyperthermia. Gradual deterioration over a period of up to two weeks results in coma, or death from cardiac or respiratory failure.

Rabies is widespread, but is not found in the Pacific Islands, or some Caribbean islands. Up-to-date information on geographic distribution can be found on the WHO web site.

The major advantage of pre-exposure rabies vaccination is that it simplifies the post-exposure treatment regimen required should a traveller be exposed. If an unvaccinated traveller is bitten, full rabies post-exposure prophylaxis (PEP) is required. This consists of the administration of human rabies immunoglobulin (HRIG), ideally within 48 hours of the exposure, and a series of five vaccinations over the course of one month. HRIG is in short supply throughout the world and is unobtainable in most developing countries.

Even in a country like Thailand, which is considered a 'model developing country' in regards to rabies control, one survey showed that the supply of HRIG was a problem in over 50% of the country's hospitals.²⁷ If a traveller who has received pre-travel vaccination is bitten, they require only two injections of vaccine over the course of three days and no HRIG. Vaccine is widely available throughout most of the developing world. Thus post-exposure treatment is vastly simplified, and the potential stress involved in trying to obtain adequate PEP is greatly reduced.

Rabies pre-exposure vaccination involves a series of three injections ideally administered at Day 0, 7 and 28. Rapid schedules can be administered, but they may result in lower antibody levels. The standard dose is 1 ml intramuscular; however, the vaccine can also be given via the intradermal route. This offers a cost saving to the traveller but should only be done by an experienced practitioner, and with the proviso that antibody levels are checked 2–6 weeks post-vaccination, as seroconversion rates are not 100%.²⁸ For practical purposes intradermal vaccination should be limited to the travel-medicine-clinic setting and intramuscular vaccination is always preferred if the budget allows. A

booster is recommended after one year and thence based on antibody levels.

Vaccination is recommended to all travellers spending more than three months in endemic areas and those who are more specifically at risk if doing shorter trips, e.g., children, cyclists, cavers, animal handlers and naturalists.

TUBERCULOSIS

It is estimated that one third of the world's population is infected with tuberculosis and as the human immunodeficiency virus (HIV) epidemic spreads so the tuberculosis situation worsens.

Tuberculosis is a subacute or chronic granulomatous disease caused by *Mycobacterium tuberculosis* that may affect any organ or system in the body. Depending on the infecting dose and an individual's natural resistance the untreated infection may heal completely or with varying degrees of scarring, undergo remission leaving a latent focus which may become reactivated or may progress to active disease.

The risk of tuberculosis infection in travellers has been studied only recently. The most relevant study was a multi-centre, prospective cohort study of 1,072 BCG-naive immunocompetent individuals visiting highly endemic countries (disease rate >100/100,000) for between three and 12 months.²⁹ The overall incidence rates were 3.5/1,000 person months for latent infections and 0.6/1,000 for active disease. However, healthcare workers had a significantly higher rate of latent infection at 7.9/1,000 per person month. The authors concluded that

*"the risk of M. tuberculosis infection in long-term travellers to high-endemicity countries, even if not engaged in health care work, is substantial and of similar magnitude to the average risk for the local population. BCG vaccination or pre and post travel tuberculin skin testing of high risk travellers should be considered."*²⁹

There are others who argue that in view of the problems associated with Mantoux testing – lack of specificity and sensitivity as well as compliance issues – it is not worth routinely testing travellers. Rather, they suggest awaiting the rare case of development of clinically overt disease and then treating appropriately.³⁰

There are no clear guidelines as to the role of BCG, or pre- and post-travel skin testing in adult travellers. It is, however, generally agreed that children under the age of five spending more than three months in a highly endemic environment should receive the BCG vaccine. In adults the role of BCG remains unclear and most travel medicine practitioners will take either of the above-mentioned approaches, pre- and post-travel skin testing, or waiting for overt disease. An experienced travel-medicine practitioner should be consulted for advice regarding risk management of tuberculosis in the long-term traveller.

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