Paediatric travel medicine: vaccines and medications

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The paediatric aspects of travel medicine can be complex, and individual advice is often required. Nonetheless, children are much more likely to acquire common infections than exotic tropical diseases whilst travelling. Important exceptions are malaria and tuberculosis, which are more frequent and severe in children. Overall, travellers' diarrhoea is the most common illness affecting travellers. This review discusses vaccines and medications that may be indicated for children who are travelling overseas. It focuses on immunizations that are given as part of the routine schedule, as well as those that are more specific to travel. Malaria and travellers' diarrhoea are also discussed.

Introduction

It is becoming increasingly common for families with young children to travel overseas to exotic locations. Travelling with children poses some challenges but can also be very rewarding. Children encounter the same problems as adults, but do not always receive appropriate pretravel advice. There are some issues that are more complex to deal with in children. For example, some travel-related vaccines are not immunogenic in young children, and the use of certain vaccines or medications that are first line in adults may be contraindicated in children.

Rather than unusual tropical diseases, travel-related illness in children is more likely to be due to common problems, such as trauma, skin and respiratory tract infections and diarrhoea. Malaria and tuberculosis are important exceptions; both tend to be more frequent and severe than in adults [1–4].

This review discusses vaccines and medications that may be indicated for children travelling overseas.

Immunizations

Routine immunizations

Many of the diseases for which routine immunizations are given are rarely seen in industrialized countries. However,

some remain prevalent in developing countries; examples include measles in many African countries [5, 6]. Travelling children may be at risk of these vaccine-preventable diseases. Influenza, varicella and measles all cause morbidity in travellers [7, 8].

Routine immunization schedules vary from country to country. However, most include some or all of the following vaccines: hepatitis B; diphtheria–tetanus–pertussis (DTP); poliomyelitis (polio); *Haemophilus influenzae* type b (Hib); pneumococcal conjugate (7-, 10- or 13-valent; PCV); meningococcal C conjugate (MenCCV); measles–mumps–rubella (MMR); varicella; influenza; and human papillomavirus (HPV).

Young children may not be fully immunized with the routine schedule vaccines. It is worthwhile ensuring that a child's immunization schedule is up to date at the time of travel. Moreover, it may be prudent to accelerate the schedule. Newer multivalent and conjugate vaccines may not be available in some of these countries, or may not be included in their national vaccination programmes [9].

Almost all of the routine vaccines can be given earlier and more frequently than national schedules recommend (see Tables 1 and 2). For example, DTP-containing vaccines, which are given at 2 months according to many national schedules, can be given from 6 weeks, and subsequent doses given 4 weeks apart. This means that the primary course of DTP vaccine could potentially be completed by

Table 1

Lower age limit and minimum interval between doses of vaccines

Vaccine	Lower age limit	Minimum interval between doses 1 and 2 (weeks)	Minimum interval between doses 2 and 3 (weeks)	Minimum interval between doses 3 and 4 (weeks)
DTP	6 weeks	4	4	4
Polio	0	4	4	4
Hib (PRP-OMP)	6 weeks	4	52	—
Hib (PRP-T)	6 weeks	4	4	52
Hepatitis B	0	4	8	8
MMR	9 months	4	—	—
MenCCV	6 weeks	8	8	—
PCV	6 weeks	4	4	—
Rotavirus (Rotarix®)	6 weeks	4	—	—
Rotavirus (RotaTeq®)	6 weeks	4	4	—
Varicella (Varilrix®)	9 months	4	—	—
Varicella (Varivax®)	12 months	4	—	—

DTP, diphtheria–tetanus–pertussis; Hib, *Haemophilus influenzae* type b; MenCCV, meningococcal C conjugate; MMR, measles–mumps–rubella; PCV, pneumococcal conjugate (7-, 10- or 13-valent); polio, poliomyelitis; PRP-OMP, polyribosylribitol phosphate-outer membrane protein conjugate; PRP-T, polyribosylribitol phosphate conjugated with Tetanus toxoid.

Table 2

Accelerated schedules for vaccines

Vaccine	Age routinely given	Accelerated schedule for travel
DTP	2, 4, and 6 months and 4 years	6, 10 and 14 weeks and 4 years
Polio	2, 4, and 6 months and 4 years	Birth, 1 and 2 months $\pm$ 3 months and 4 years
Hib	2, 4 and 12 months	6, 10 and 14 weeks, preferably 2, 3, 4 and 12 months
MMR	12 months and 4 years	9 months and 4 years
Hepatitis B	2, 4 and 6 or 12 months	Birth, 1 and 2 months, followed by a fourth dose 6–12 months later
PCV	2, 4 and 6 months	6, 10 and 14 weeks

DTP, diphtheria–tetanus–pertussis; Hib, *Haemophilus influenzae* type b; MMR, measles–mumps–rubella; PCV, pneumococcal conjugate (7-, 10- or 13-valent); and polio, poliomyelitis.

14 weeks of age. An accelerated schedule may be of particular benefit to an infant being taken overseas for several months in their first year of life.

Injectable polio vaccine If the third dose of injectable polio vaccine is given after 4 years of age, a fourth dose is not required. However, if using a combination vaccine, it is acceptable to receive a fourth dose.

Measles–mumps–rubella vaccine Measles is still common in many countries, and travel in densely populated areas may favour transmission. The MMR vaccine may be given from 9 months of age. Children given MMR at less than 12 months of age should receive a booster 3 months later.

Hepatitis B vaccine Regardless of travel, all children should be immunized against hepatitis B, because infection at an early age carries a higher risk of chronic infection. Infection most often occurs by social contact with other children and cannot be effectively prevented by any other means. If the first dose is given at birth or within 7 days of birth, then three subsequent doses should be given; otherwise two subsequent doses are required.

Pneumococcal conjugate vaccine The incidence of invasive pneumococcal disease is higher in less-developed countries than in many industrialized countries. Pneumococcal conjugate vaccine is the preferred pneumococcal vaccine for children under 5 years of age. It should be offered to all children aged between 3 months and 2 years, and to those with underlying medical conditions under the age of 5 years. The polysaccharide vaccine may be offered in certain circumstances.

Meningococcal C conjugate vaccine (MenCCV) If two doses of MenCCV are given before 12 months of age, a booster dose should be given at 12 months of age.

Varicella vaccine If a child receives varicella vaccine at less than 12 months of age, a further dose should be given at 18 months of age. Children over the age of 12 years should receive two doses, 4–8 weeks apart.

Influenza vaccine Influenza is one of the most common travel-acquired vaccine-preventable diseases [7, 8]. Influenza infection can cause significant disruption to a family's travel plans. Vaccination should therefore be considered

for all children greater than 6 months of age travelling during the (local) influenza season. It is especially important in children with risk factors, including underlying chronic cardiorespiratory disease, a neurological condition or impaired immunity.

Travel-specific vaccines

Travel-specific vaccines that may be recommended or required, depending on the particular trip, include: hepatitis A; typhoid; meningococcal A, C, W-135, Y; Bacille Calmette–Guérin (BCG); yellow fever; rabies; Japanese encephalitis; and cholera.

Hepatitis A vaccine Hepatitis A is a significant cause of morbidity globally, although the mortality rate is low. It is transmitted from person to person by the faecal–oral route and through contaminated food and water. Improved sanitation and living standards mean that fewer countries remain highly endemic, but in countries where the endemicity of hepatitis A is low or intermediate, more people lack immunity to hepatitis A virus (HAV) infection, and the risk of outbreaks grows. Travellers from these countries to endemic regions are at particular risk.

Exposure to HAV in the first 6 years of life usually results in mild or asymptomatic infection [10, 11]. It could therefore be argued that children under 6 years do not require hepatitis A vaccine, because if infected, they will most probably remain well and will develop natural lifelong immunity. However, HAV is excreted in saliva and stool for up to 6 weeks after infection; these children may therefore spread hepatitis A to others, particularly on their return to their home country.

Given that the hepatitis A vaccine is safe, effective and long lasting, it should generally be offered to all children over the age of 1 year. However, it may be reasonable to waive immunization of children less than 6 years old, particularly if they are travelling for more than 6 weeks, because by the time they return, they are unlikely still to be excreting HAV.

There are a number of inactivated hepatitis A vaccines, some of which are combined vaccines (with typhoid or hepatitis B). Although the vaccines are prepared from differing strains of HAV, there is only one known serotype; immunity induced by a particular strain probably provides protection against all strains [12].

Paediatric formulations of hepatitis A vaccine are available for children from 1 year of age. The vaccines are highly immunogenic, and protective efficacy approaches 100% [13]. Serological testing to assess immunity after vaccination is unnecessary. As in adults, a single dose is given, followed by a booster 6–12 months later. However, immunity may persist for up to 8 years after a single dose of hepatitis A vaccine [14, 15], and there is no evidence to support booster doses after a full primary vaccination course in a healthy individual [16, 17].

Typhoid vaccine The vast majority of typhoid (and paratyphoid) fever cases occur in less-developed countries, where poor sanitation, poor food hygiene and untreated drinking water all contribute to endemic disease with moderate to high incidence and considerable mortality. Geographic regions with high incidence (>100 cases per 100 000 population per year) include the Indian subcontinent, most southeast Asian countries and several south Pacific nations, including Papua New Guinea.

In industrialized countries, typhoid fever is predominantly a travel-related disease, with a considerably greater risk following travel to the Indian subcontinent than to other regions [18]. Those who travel to endemic regions to visit friends and relatives appear to be at considerably greater risk of acquiring typhoid fever than other travellers [19, 20]. For example, there are approximately 50–80 cases of typhoid fever reported in Australia each year, with most following travel to regions with endemic disease [21].

Two typhoid vaccines are available: injectable polysaccharide and oral live attenuated vaccines. Injectable killed Vi typhoid vaccine can be given to children aged 2 years and over. Only one dose is required, and side-effects are minimal. The optimal timing of revaccination against typhoid fever is uncertain, and therefore, international recommendations vary considerably [22].

However, if repeated or continued exposure to *Salmonella typhi* is likely to occur, a second dose of the parenteral vaccine should be given 3 years after the initial primary vaccination.

The oral vaccine is as effective as the injectable one, has few side-effects, and is safe in children over the age of 1 year, although it is not generally recommended for children younger than 6 years. The factor limiting its use in children is their ability to swallow the capsules. The vaccination schedule consists of one capsule of vaccine on days 1, 3 and 5. The capsule must be swallowed whole with water and must not be chewed, because the organisms can be killed by gastric acid. It should not be given concurrently with antibiotics that are active against *S. typhi*. If possible, antibiotics and other relevant drugs should be delayed for 3 days after the last dose of the vaccine. A fourth capsule taken on day 7 has been shown to result in a lower incidence of typhoid fever than three doses [23].

Meningococcal A, C, W-135, Y vaccine Meningococcal vaccine covering serotypes A, C, W135 and Y is indicated for children travelling to highly endemic areas, particularly sub-Saharan Africa (see Figure 1) and parts of the Middle East.

A polysaccharide vaccine has been available for many years. However, this vaccine is not immunogenic against serogroup A in children less than 3 months of age, nor against serogroup C in children less than 18 months of age.

Two quadrivalent (A, C, W-135 and Y) conjugate vaccines are now available, and a third is under investigation.

Figure 1

African countries with frequent epidemics of meningococcal meningitis [32]. <http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-3-infectious-diseases-related-to-travel/meningococcal-disease.htm#2572>

MenACWY-CRM, known as Menveo®, consists of meningococcal groups A, C, Y and W-135 oligosaccharides conjugated to CRM197 (nontoxic diphtheria toxin mutant) [24]. This vaccine is licenced for use only in children over 11 years of age. However, the vaccine is safe and immunogenic in infants as young as 2 months [25]. An ACWY vaccine in which the polysaccharides are conjugated to diphtheria toxoid (Menactra®) is licenced from the age of 9 months [26].

Bacille Calmette–Guérin vaccine Risk of potential exposure to tuberculosis should be assessed at a pretravel consultation. For many travellers, the risk will be low. However, families who are visiting friends and relatives in developing countries may be at high risk of exposure, even if their trip is short [27, 28]. The protective efficacy of BCG is only 50% overall, but it is approximately 80% protective against disseminated tuberculosis, tuberculous meningitis and death from tuberculosis, which are more common in young children [4, 29, 30]. The BCG vaccine is recommended for these children less than 5 years of age who are

expected to stay for more than a few weeks in areas with a high prevalence of tuberculosis (this includes most developing countries).

Prior tuberculin skin testing is indicated only if there is deemed to be the possibility of previous exposure to tuberculosis [31]. The dose of BCG for infants less than 12 months of age is 0.05 ml given intradermally, and 0.1 ml after 12 months of age.

Yellow fever vaccine Yellow fever vaccine entry requirements are established by countries to prevent the importation and transmission of yellow fever virus, and are allowed under the International Health Regulations. Travellers must comply with these to enter the country, unless they have been issued with a medical waiver. Certain countries require vaccination from travellers arriving from all countries, while some countries require vaccination only for travellers coming from a country with risk of yellow fever transmission. Country requirements are subject to change at any time. The Centers for Disease Control provides up-to-date details [32] <http://wwwnc.cdc.gov/travel/yellowbook/>

Figure 2

Yellow fever vaccine recommendations in Africa, 2010 [32]. <http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-3-infectious-diseases-related-to-travel/yellow-fever.htm#2853>

2012/chapter-3-infectious-diseases-related-to-travel/yellow-fever.htm, as does the World Health Organization [33] <http://www.who.int/ith/en/>, which also has an interactive map (<http://apps.who.int/tools/geoserver/www/ith/index.html>). Figures 2 and 3 show the yellow fever vaccine recommendations in Africa and the Americas.

The vaccine should be given to children aged greater than 9 months travelling in the relevant countries. It should not be given to children younger than 6 months, owing to the risk of vaccine-associated encephalitis.

Rabies vaccine Rabies is endemic throughout much of Africa, Asia, the Americas and Europe, where the virus is maintained in certain species of mammals [34, 35]. Rabies virus is transmitted in the saliva of rabid mammals via a bite. The incubation period usually ranges from 1 to 3 months after exposure, but can range from days to years. Infection is almost always fatal.

Rabies vaccine can be given for prophylaxis before or after exposure, although the former is more reliable. Pos-

texposure prophylaxis also includes prompt wound care and the administration of rabies immunoglobulin. Access to appropriate rabies immunoglobulin and rabies vaccine cannot be assured in all countries. Those who have completed a pre-exposure vaccine course and are subsequently exposed to rabies need less vaccine and no rabies immunoglobulin treatment.

Rabies vaccine is recommended for children over 1 year of age staying for prolonged periods in endemic areas, particularly where rabies immunoglobulin and vaccine are difficult to obtain. Vaccination is more important in children than in adults, because they are attracted to animals and are more likely to try to pat, play with or feed them, may not reliably report a minor animal bite, and are more likely to suffer animal bites that are severe and multiple, or involve the upper limbs, head and neck [34].

Vaccination consists of a total of three intramuscular injections of 1 ml of vaccine; the second and third doses are given on day 7 and 28 after the first. The vaccine is expensive; if cost is prohibitive and more than one person

Figure 3

Yellow fever vaccine recommendations in the Americas, 2010 [32]. <http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-3-infectious-diseases-related-to-travel/yellow-fever.htm#2854>

is to be immunized, an effective alternative is to give 0.1 ml of vaccine intradermally [36]. However, antibody levels are lower and decline more rapidly following intradermal compared with intramuscular immunization.

Japanese encephalitis vaccine Japanese encephalitis (JE) is a mosquito-borne flavivirus infection and the most common vaccine-preventable form of encephalitis in Asia. It is a significant public health problem in many parts of Asia, including India, Sri Lanka, southeast Asia and China, and outbreaks have occurred in northern Australia [37, 38].

Japanese encephalitis virus is transmitted in a cycle between *Culex* species mosquitoes and birds, with pigs serving as amplifying hosts. Humans are an incidental host, infected when living in close proximity to this cycle, usually in rural areas with lots of water (e.g. rice fields). Clinical JE is a severe disease, with a high case fatality rate (30%). Up to 50% of those who survive encephalitis suffer from long-term or permanent disabilities, such as physical and mental impairments. The risk of JE in travellers to endemic areas is very low, although it is likely to be higher in those who stay for prolonged periods in rural areas [39].

Although JE vaccines have been available for many years, serious adverse effects that were temporally associated with vaccination led to their discontinuation. Two new JE vaccines have recently become available: a purified inactivated vaccine containing the attenuated SA14-14-2 JE virus (JESPECT® or IXIARO®) and a live attenuated yellow fever–JE chimeric viral vaccine (IMOJEV®) [40].

Japanese encephalitis vaccine is recommended for children greater than 1 year of age who will spend at least 1 month in endemic rural areas of Asia, or a year or more than 6 months in nearby endemic urban areas. However, the vaccine that has been used in many industrialized countries for several years was highly reactogenic and is no longer being manufactured. Reactions to the vaccine (for example, fever and aches and pains) are common in children. JESPECT®/IXIARO® is not currently indicated for children less than 16 years of age. Phase 3 studies in children are ongoing [39, 41–43]. It has been shown to be safe and immunogenic down to 2 months of age (K. Dubischar-Kastner, unpublished data). IMOJEV® is indicated for use in children from the age of 12 months [40], but is not widely available.

Cholera vaccine The risk of cholera is extremely low for most travellers. The vaccine is recommended only if travel is to an area with a known outbreak. The oral live-attenuated vaccine (Dukoral®) can be given to children greater than 2 years.

Travellers' diarrhoea

Travellers' diarrhoea (TD) is the most common illness in travellers to developing countries; it affects up to 70% of those who visit developing countries [44]. It is part of the spectrum of gastrointestinal infections that travellers may encounter [45, 46].

Children are more likely to acquire TD, because they have reduced killing of ingested bacteria owing to their higher gastric pH and more rapid gastric emptying time. Moreover, they are more immunologically naïve, and young children may be indiscriminate about what they put in their mouths.

Aetiology of TD

Bacteria cause 50–75% of cases of TD, viruses 5–20% and parasites up to 10% [47, 48]. Enterotoxigenic *Escherichia coli* (ETEC) is the most common cause overall. Co-infection with one or more pathogens occurs in 10–15% of cases. The aetiology is much the same in children [49]. The aetiology of TD is shown in Table 3.

Prevention of TD

The most important way of preventing of TD is to avoid contaminated food and water. Standard advice includes drinking boiled or bottled water only, eating freshly

Table 3

Aetiology of travellers' diarrhoea

Pathogen	Frequency (%)
Bacteria	50–75
Enterotoxigenic <i>Escherichia coli</i>	10–45
<i>E. coli</i> (enteroaggregative)	5–35
<i>Campylobacter</i> spp.	5–25
<i>Salmonella</i> spp.	0–15
<i>Shigella</i> spp.	0–15
Viruses	5–20
Noroviruses	0–10
Rotavirus	0–5
Parasites	0–10
<i>Giardia intestinalis</i>	0–5
<i>Cryptosporidium</i> spp.	0–5
No pathogen identified	10–50

cooked food and eating only those fruit or vegetables that have been bought whole and peeled. Water may be disinfected with iodine or chlorine.

The oral cholera vaccine, Dukoral®, combines killed *Vibrio cholerae* with purified recombinant cholera B subunit, which is nearly identical to the heat-labile toxin of ETEC. This vaccine provides approximately 60% protection against ETEC for 3 months; the protection against TD is much lower [50, 51]. In a study of the vaccine in Finnish tourists to Morocco, overall reduction in TD was 23% [52]. Two doses must be taken at least 1 week apart, and at least 1 week before travelling to an at-risk area; for children between 2 and 6 years, three half-doses are taken at weekly intervals.

A new vaccine with heat-labile enterotoxin from ETEC delivered via a skin patch may be effective and is being studied. In a phase 2 study in adults, the patch had a 70% protective efficacy against moderate-to-severe diarrhoea and 84% efficacy against severe diarrhoea [53]. Although there is some evidence for the use of antibiotics to prevent TD, antibiotic prophylaxis is generally not recommended.

A recent randomized controlled trial of a tablet formulation of hyperimmune bovine colostrum for prevention of TD showed protective efficacy of up to 90% against ETEC [54]. However, tablets must be taken before every meal, which may limit its practicability, and concerns about instability of the formulation have led to its recall in the USA.

Treatment of TD

The emphasis in management should be on fluid and electrolyte replacement and continued nutrition. Antimotility agents, such as loperamide and diphenoxylate, may provide symptomatic relief, but should be used with caution in children, because they may cause lethargy, ileus and coma. They are contraindicated below different ages in various countries. Antiemetics, e.g. metoclopramide

(Maxolon®), prochlorperazine (Stemetil®) or ondansetron (Zofran®) should be avoided in children under 2 years of age. Ondansetron is available as a wafer, which may be easier to administer than a tablet. Dystonic reactions caused by antiemetics are more commonly seen in children.

Prompt (self) administration of antibiotics is effective in the treatment of TD [55]. Ciprofloxacin and azithromycin are the best choices, given the aetiology of TD. The latter is particularly recommended for Southeast Asia, where *Campylobacter* is a higher risk [56]. Rifaximin is a rifampicin analogue that is poorly absorbed from the gastrointestinal tract. It treats non-invasive enteric organisms and has been shown to be effective in the treatment of TD [57, 58]. It is approved by the US Food and Drug Administration for the treatment of TD caused by non-invasive strains of *E. coli* in patients aged 12 years and older. It has been studied in children from the age of 8 years with inflammatory bowel disease and shown to be safe [59].

Malaria

The risk of malaria (and other insect-borne diseases) can be substantially reduced by minimizing mosquito exposure, particularly at dawn and dusk. This can be achieved to some extent by wearing light-coloured clothes that cover the arms and legs and using mosquito nets. Impregnating clothes and nets with the insecticide permethrin has been shown to reduce malaria infection rates [60]. *N,N*-Diethyl-3-methylbenzamide, formerly known as *N,N*-diethyl-*m*-toluamide (DEET), is the most effective insect repellent available [61, 62]. Products with up to 30% DEET can be used safely in children [63]. There have been numerous case reports of toxicity associated with DEET in children. However, these have mostly been poorly documented, and in many, >30% DEET was used and applied excessively. A retrospective study of 9086 reports of DEET toxicity showed that children were no more likely to develop adverse effects than adults; two-thirds of those exposed had no adverse effects, and 99% had no long-term sequelae [64].

Detailed information regarding the selection of specific antimalarials for chemoprophylaxis and treatment of malaria is beyond the scope of this review.

Prophylaxis

Young children are at increased risk of severe *Plasmodium falciparum* malaria, and death may occur within 24 h of the onset of symptoms. Chemoprophylaxis should be offered to all children travelling to areas where malaria transmission is high. However, there are lower age/weight limits for each of the most commonly used drugs. None of them is widely available as a suspension.

The antimalarials most commonly used for prophylaxis include mefloquine, doxycycline and atovaquone-proguanil (Malarone®). Randomized controlled trials show that these all have similar efficacy (>95%) against *P. falciparum* [65, 66]. Some countries advocate chloroquine plus proguanil for the limited regions of low-level chloroquine resistance, such as parts of India and Indonesia. Chloroquine remains effective only in Mexico, areas of Central America that are west of the Panama canal, the Caribbean, East Asia and a few Middle Eastern countries.

All antimalarial chemoprophylactic regimens are associated with mild adverse events, but serious events are rare [67, 68]. Chloroquine, proguanil and quinine are safe to give to children of all ages. Mefloquine tends to be tolerated better by children than adults [69]. It can be given to children over 5 kg. Many mefloquine-associated adverse events occur by the third dose [70]. Starting mefloquine prophylaxis 3 weeks before departure allows for evaluation of tolerability to the regimen. Atovaquone-proguanil (Malarone®) is not recommended for prophylaxis in children who weigh less than 5 kg. Paediatric tablets are available and can be given to children over 5 kg in weight. It is generally very well tolerated. Doxycycline is contraindicated for children under 8 years of age (and mothers who are breastfeeding) because it affects growing bones and teeth. Each of these drugs is excreted in breast milk but will not protect the breastfed infant.

Table 4 provides summary information about the three most commonly prescribed antimalarials for prophylaxis.

Table 4

Commonly prescribed antimalarials for prophylaxis

Medication	Dosing	Minimal weight and/or age	Adverse effects
Doxycycline	Daily (2 days before entering malaria-endemic region until 4 weeks after leaving)	8 years	Photosensitivity, thrush (common)
Mefloquine	Weekly (3 weeks before entering malaria-endemic region until 4 weeks after leaving)	5 kg/3 months	Neuropsychiatric side-effects (rare)
Atovaquone-proguanil	Daily (2 days before entering malaria-endemic region until 1 week after leaving)	5 kg	Abdominal pain, headache, nausea, vomiting (not uncommon)

Treatment

Artemisinin-based combination therapies are now the recommended treatment for *P. falciparum* malaria worldwide. As the effectiveness of chloroquine for treatment of *Plasmodium vivax* declines, alternative therapies are needed. Artemisinin-based combination therapies appear at least equivalent to chloroquine at effectively treating the blood-stage *P. vivax* infection [71]. One of the most commonly used artemisinin-based combination therapies, artemether–lumefantrine (Coartem® or Riamet®) achieves high cure rates and rapid resolution of parasitaemia, fever and gametocytaemia in adults and children, and has an excellent safety and tolerability profile [72]. Newer artemisinin-based combination therapies, such as dihydroartemisinin–piperaquine, appear to be associated with a lower risk of recurrent infections [73].

Air travel

Children may find it very difficult to settle on a long flight, and this may be distressing to them, their parents and others. Sedation may assist them to relax and fall asleep. Chloral hydrate has been well studied in children and is safe and effective [74]. It is available as a suspension and has a wide dosing range. Doses as low as 8 mg kg⁻¹ can be given and repeated during the trip if required (up to 50 mg kg⁻¹), or up to 50 mg kg⁻¹ can be given as a single hypnotic dose. Adverse effects include gastric irritation and vomiting in 5%, which can be reduced by diluting with water or milk. Importantly, paradoxical agitation occurs in only 1–2%, compared with up to 15% for antihistamines such as promethazine (Phenergan®).

Conclusion

The paediatric aspects of travel medicine can be complex. This review provides some information regarding the vaccines and medications that may be indicated for children who are travelling overseas.

Competing Interests

There are no competing interests to declare.

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