CHAPTER 12

Travel Advice for Pediatric Travelers: Infants, Children, and Adolescents

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Pediatric travelers present unique challenges to the travel medicine provider. Each facet of travel medicine has special caveats relating to the different developmental stages, sizes, and maturity levels of the infant, child, or adolescent traveler. In addition, children traveling to any destination require attention to basic pediatric issues. This chapter reviews specific travel medicine issues in the pediatric population.

DEVELOPMENTAL ASPECTS AND TRAVEL

A journey with a child presents many opportunities and challenges. They open many doors for cultural experiences that would not be readily available otherwise. Newborns can be easily transported, their schedules adjusted to time zone changes and they can be protected from many environmental and dietary risks of travel. Children thrive on routine. Toddlers are often the most challenging age. Their mobility presents safety and infectious exposure issues. They are more vulnerable to diarrhea due to hygiene and oral-fecal contact. Toddlers should be carefully labeled with identification that is carried in a waistpack or affixed to their clothing. The child's name, birth date, citizenship, and passport number should be included, along with the telephone number and address of the appropriate consulate or embassy in the destination country. An active, curious toddler can easily wander off in a crowded airport, train station, or market. The use of a chest harness on the child with a tether to an accompanying parent or adult is strongly recommended. Toilet training may be interrupted when a change in routine occurs. Lowering adult expectations of traveling toddlers is wise. Older children may be reluctant to use unfamiliar toilets, so carrying an extra change of clothing and toddler pants is recommended. Using the toilet on the airplane just before de-planing avoids the problem of unavailability or phobia of facilities in overseas terminals. Diaper availability may be limited in some developing countries. Diaper liners can be helpful for disposal of stool when in remote locations. Advise families traveling to Africa about the Tumbu fly. Cloth diapers dried in the sun can have fly eggs deposited on them and later result in larval myiasis when used. Although work intensive, ironing cloth diapers and other articles of clothing dried in the sun will kill the eggs and ensure safety.

School-aged children need education about safety and traffic concerns. They should be aware of dangers of animal encounters such as bites, licks or scratches and instructed to report any contact to a parent. The unfamiliar environment may be particularly challenging to certain youngsters. Bringing along familiar home toys, blankets or books may be comforting.

Many high schools students travel abroad for work or study. The adolescent traveling without a parent should be counseled, in a private session, regarding preventive measures against human immunodeficiency virus infection and other sexually transmitted diseases. Providing information on abstinence and safe sex practices, as well as advising against any tattoos or body piercings or unnecessary dental or cosmetic surgery abroad, should be part of preparing these young travelers. Contraceptive counseling for teens and availability of oral contraceptives, or emergency contraceptives should be included (Chapter 13).

AIRLINE TRAVEL

Occupying children with activities during long airplane flights is intuitive for most parents. Pens, paper, playing cards, and books are essential elements of the carry-on bag. Water and snacks are helpful to have during long waits in hot airline terminals and can salvage difficult delays in customs terminals. Special meals can be ordered ahead of time for children when planning an airplane flight.

Airline regulations vary regarding children traveling alone on planes. Generally, children <5 years old are not permitted to travel unaccompanied by an adult. The child's age and maturity level should be taken into account when considering whether to send them alone. Non-stop flights are preferable, and contingency plans should be set up, in case delays or cancellations occur. Special passes may be obtained at airline ticket counters for parents to accompany their minor child to the departure gate through security. The child should be comfortable with requesting help from the flight attendants and be told what to expect during a normal flight. Education on personal and stranger safety issues is best reinforced at this time.

Children under 40 pounds are safest in airplanes if riding in an approved child restraint system. Though not required, the Federal Aviation Administration (FAA) strongly recommends their use. Holding young children on the lap or buckling them in the same seat belt as the adult carrying them is hazardous during severe turbulence, rough landings, and crash situations. Federal safety standards have found that all child restraint seats manufactured after January 1, 1981 adequately protect children under 40 pounds on an airplane. A sticker stating that all applicable FAA standards have been met for airplane travel identifies appropriate seats. Child restraint systems without this sticker are not allowed on the plane. The airline's infant-seat policy should be checked at the time reservations are made. Many airlines offer discounted seats for children using restraint systems. Choosing off-peak flights may improve the chances of getting a free individual seat for the child or infant, but purchasing a full seat is the only guarantee.

Otitis media is not a contraindication to air travel. Tympanic membrane rupture is not a reported complication of flying in aircraft. Barotrauma is a theoretical concern when middle ear equilibration fails. Have the child or infant swallow during ascent and, particularly, descent to help the eustachian tube equilibrate the middle ear. Older children can be taught pressure equalization techniques such as the Valsalva maneuver to relieve the discomfort of middle ear pressure. Administering an antihistamine before the flight may help some children, but its benefit has not been conclusively reported.

Advice on sedating children with a weight-appropriate dose of over-the-counter antihistamine may be requested by the parent(s), and can be done as close to actual take-off as possible. Paradoxical reactions to antihistamines occur in a small percentage of children, and are best discovered at home, before the plane trip. Prescription

sedatives should be avoided. An unanticipated side-effect, such as respiratory depression, can be much more serious in-flight, where medical care is unavailable.

Past recommendations have suggested that infants <6 weeks old should not travel by air. No data exist to support the restriction of healthy infants flying on airplanes. The avoidance of infectious diseases between birth and 2 months old is of prime concern to parents and healthcare providers, as fever in a neonate <2 months old requires urgent medical evaluation at home or while traveling.

There is an expanding market of travel-related gear for children and their parents, from child-sized neck pillows to inflatable potties to breast pump backpacks. Convertible airplane-ready strollers that roll down aisles easily, then convert to carseats and later, feeding booster seats make travel more convenient than in the past. Most vendors are easily located on the Internet. While electronic equipment (DVD/MP3/handheld games) are useful entertainers at times, the battery requirements and electrical incompatibility may limit their overall usefulness during prolonged trips abroad.

MOTION SICKNESS

Children suffering from motion sickness present particular challenges to mobile families. Non-pharmacologic treatment includes sitting susceptible children beside a window, facing forward, and avoiding heavy meals before travel. Wearing dark glasses and nighttime travel may also reduce symptoms. Ginger preparations have not been tested in children.

Acceptable and safe medications for motion sickness in children are listed in Table 12.1. Over-the-counter preparations will usually suffice for mild to moderate symptoms. The use of promethazine should be reserved for children over

TABLE 12.1 Medications for motion sickness

	Dose	Comments
Over-the-counter		
Diphenhydramine	5 mg/kg per day p.o. divided q.i.d.	Strong sedative effect; available in liquid form
Dimenhydrinate	2–6 years: 12.5–25 mg p.o. t.i.d., to maximum 75 mg/day 6–12 years: 25–50 mg p.o. t.i.d., to maximum 150 mg/day >12 years: 50 mg p.o. t.i.d.–q.i.d. Adult maximum: 400 mg/day	Available in liquid form
Meclizine	>12 years: 25–50 mg p.o. once daily	Chewable tablet
Prescription		
Scopolamine (Transderm-Scop) 1.5 mg patch	>12 years: 0.5 mg patch behind the ear every 3 days	Apply at least 4 h before expected symptoms; wash hands after applying; do not cut patch
Promethazine	>2 years: 0.5 mg/kg per dose p.o. q8–12 h p.r.n.	Good for severe symptoms; may cause profound sedation. Contraindicated for under 2 year olds

2 years with severe symptoms. Any of these medications are best given 1 h before the anticipated symptoms occur.

VACCINE SCHEDULES FOR INFANTS AND CHILDREN

Immunization against common vaccine-preventable diseases occurs routinely throughout the first 24 months of life and mirrors routine pediatric health supervision visits. Routine vaccination schedules have changed yearly or more in the past 10 years. The varicella (Var) vaccine is recommended for all children at 12 months of age and older. The measles-mumps-rubella (MMR) vaccine is recommended at 12 months. Second doses of both MMR and varicella vaccines are routine at 4–6 years of age. Polio vaccine recommendation was modified in 2000 to an all-inactivated polio vaccine schedule for routine childhood vaccination in the USA. In countries where the oral polio vaccine (OPV) is still used, the relative risk of vaccine-associated poliomyelitis, although very low, is non-existent with the sequential schedule. The heptavalent pneumococcal conjugate vaccine (PCV) is recommended for infants and children 2–23 months of age. Influenza vaccination is routinely recommended for all children older than 6 months, regardless of travel plans. Meningococcal meningitis conjugate vaccine is routinely recommended at age 11–12 years, high school entry or pre-college as a one-time dose. Shortages limit the recommendations for conjugate meningococcal vaccine administrations and high-risk groups are prioritized. An adolescent booster for both tetanus and pertussis is given at age 10–11 years. The reduced pertussis/tetanus/diphtheria vaccine (Tdap) is given if 5 years have elapsed from the last tetanus shot. Further tetanus boosters should be given as Td. Conjugate meningococcal vaccine, if indicated, is best administered at the same time as Tdap. A vaccination against four strains of human papilloma virus (HPV) known to cause cervical cancer is available and recommended routinely in a three-dose series (0, 2, 6 months) for girls >11 years. It is not currently licensed for use in males.

Minor febrile illnesses are not a contraindication to any of the routine vaccines. Simultaneous administration of vaccines is acceptable and does not diminish antibody response. Give live viral vaccines together or, if separate, at least 30 days apart. Current recommendations for childhood vaccination are summarized in Figure 12.1.

International travel increases the risk of exposure to communicable diseases. It is important for a young infant or child going abroad to receive as much protection as possible against preventable diseases. Unique vaccine considerations exist for children, which guide choices before travel. Routine vaccines may have to be given on an accelerated schedule, with recommendations for extra booster doses. An acceptable schedule for accelerating routine vaccines is found in Table 12.2. Some travel vaccines, such as yellow fever vaccine, have a higher rate of serious complications in the young infant and are not recommended until a certain age is attained (9 months for yellow fever vaccine). Other vaccines, such as meningococcal polysaccharide vaccine, are not optimally immunogenic in children <3 years old. Still others, such as hepatitis A, are not approved for use in children under certain ages owing to the presence of interfering maternal antibody that limits vaccine response.

Hepatitis A is a usually a mild disease in children <5 years old. Children, however, can serve as reservoirs and infect adults and caretakers. Continuing to breast-feed traveling infants offers the advantage of added gastrointestinal immunity to enteric diseases. Immunization with the hepatitis A vaccine is recommended for

Department of Health and Human Services • Centers for Disease Control and Prevention

Recommended immunization schedule for ages 0–6 years United States, 2007

Vaccine \ Age	Birth	1 month	2 months	4 months	6 months	12 months	15 months	18 months	19–22 months	2–3 years	4–6 years
Hepatitis B[1]	**HepB**	**HepB**		*see footnote 1*	**HepB**	**HepB**	**HepB**	**HepB**	**HepB Series**	**HepB Series**	**HepB Series**
Rotavirus[2]			**Rota**	**Rota**	**Rota**						
Diphtheria, Tetanus, Pertussis[3]			**DTaP**	**DTaP**	**DTaP**		**DTaP**	**DTaP**	**DTaP**	**DTaP**	**DTaP**
Haemophilus influenzae type b[4]			**Hib**	**Hib**	***Hib***[4]	**Hib**	**Hib**	**Hib**	**Hib**	**Hib**	
Pneumococcal[5]			**PCV**	**PCV**	**PCV**	**PCV**	**PCV**	**PCV**	**PCV**	**PCV**	**PCV**
Inactivated Poliovirus			**IPV**	**IPV**	**IPV**	**IPV**	**IPV**	**IPV**	**IPV**	**IPV**	**IPV**
Influenza[6]					**Influenza (yearly)**	**Influenza (yearly)**	**Influenza (yearly)**	**Influenza (yearly)**	**Influenza (yearly)**	**Influenza (yearly)**	
Measles, Mumps, Rubella[7]						**MMR**	**MMR**	**MMR**	**MMR**	**MMR**	**MMR**
Varicella[8]						**Varicella**	**Varicella**	**Varicella**	**Varicella**	**Varicella**	**Varicella**
Hepatitis A[9]						**HepA (2 doses)**	**HepA (2 doses)**	**HepA (2 doses)**	**HepA (2 doses)**	**HepA Series**	**HepA Series**
Meningococcal[10]										**MPSV4**	**MPSV4**

Range of recommended ages

Catch-up immunization

Certain high-risk groups

Fig. 12.1 Recommended childhood and adolescent immunization schedules USA, 2007.

Continued

Department of Health and Human Services • Centers for Disease Control and Prevention

Recommended immunization schedule for ages 7–18 years United States, 2007

Vaccine \ Age	7–10 years	11–12 YEARS	13–14 years	15 years	16–18 years
Tetanus, Diphtheria, Pertussis[1]	*see footnote 1*	**Tdap**	**Tdap**		
Human Papillomavirus[2]	*see footnote 2*	**HPV (3 doses)**	**HPV Series**		
Meningococcal[3]	**MPSV4**	**MCV4**	**MCV4**	**MCV4**[3]	
Pneumococcal[4]	**PPV**				
Influenza[5]	**Influenza (yearly)**				
Hepatitis A[6]	**HepA Series**				
Hepatitis B[7]	**HepB Series**				
Inactivated Poliovirus[8]	**IPV Series**				
Measles, Mumps, Rubella[9]	**MMR Series**				
Varicella[10]	**Varicella Series**				

Range of recommended ages

Catch-up immunization

Certain high-risk groups

Fig. 12.1, *cont'd*

TABLE 12.2 Accelerated routine immunizations schedules for pediatric travelers[a]

Vaccine	Schedule
DTaP	6, 10, 14 weeks, and 6 months after dose 3
Measles, Mumps, Rubella (Accelerated single measles antigen vaccine plus MMR schedule)	
Single antigen measles vaccine	6–11 months of age
MMR, 2 doses	12 months of age, 1 month after first MMR
Inactivated polio vaccine	6, 10, and 14 weeks of age
Haemophilus influenza Type B Conjugate vaccine	
HbOC, PRP-T	6, 10, 14 weeks, dose 4 at 12 months
Hepatitis B vaccine	0, 1, 2 months. Give a booster dose at 12 months

[a]Give as many doses as possible of a vaccine series following an accelerated schedule before departure.

child travelers >1 year without pre-vaccine serology testing. Foreign-born children from developing countries may be considered for serologic testing before vaccination. Recommendations have been made from the Centers for Disease Control and Prevention in 2006 for universal childhood vaccination against Hepatitis A. Parents of children <1 year old can be given the option of immune globulin for the infant, although it is not essential, given the mild nature of the disease in young children.

Typhoid vaccination is similarly complicated by the choices available. The oral typhoid vaccine (Ty21a) in capsule form is approved for use in children >6 years. A lyophilized vaccine preparation that reconstitutes to a liquid oral suspension is available in Canada and Switzerland. This preparation can be used in children >3 years. The injectable typhoid Vi polysaccharide vaccine is an approved alternative in all countries for children >2 years. For younger infants, prudent and cautious food and water advice needs to be emphasized. The heat-inactivated phenol vaccine, although approved for use in infants at 6 months old, carries a high rate of local and systemic side-effects and is not readily available for use. Table 12.3 indicates the recommended ages and intervals for travel immunizations. Table 12.4 lists important vaccine interactions.

Yellow fever vaccination, an attenuated live virus vaccine, is absolutely contraindicated in infants <6 months old. There is a risk of vaccine associated encephalitis in this age group. Vaccination should be delayed until 9 months old. In infants 6–9 months of age, the yellow fever vaccine should only be considered if epidemic exposure exists and in consultation with experts. A letter of waiver for infants and egg allergic children can be provided before travel. Infants unable to receive the yellow fever vaccine due to age contraindications should be advised to delay travel to yellow fever endemic areas if possible until the vaccine can be safely given. Intradermal testing of egg allergic travelers can be performed prior to vaccination. The vaccine is not recommended for immunocompromised individuals.

Rabies vaccination (Table 12.4 and Chapter 5) is recommended for ambulatory children who will travel extensively (1–3 months) or live in rural villages in countries where rabies is endemic or anyone who desires maximal protection for their

TABLE 12.3 Travel vaccinations for children

Vaccine	Age	Primary series	Booster interval; comments
Cholera, oral (CVD103-HgR)[a,b]	>2 years	1 dose oral, in buffered solution	Optimal interval not established, manufacturer recommends 6 months
Hepatitis A	>1 year	Havrix (GSK): 2 doses (0.5 ml i.m.) at 0, 6–18 months later VAQTA (Merck): 2 doses (0.5 ml i.m.) at 0 and 6 months	See text
Immune globulin[c]	Birth	0.02 ml/kg i.m.	Lasts 6 weeks; see text
Japanese B encephalitis	>1 year	1–3 years: 3 doses (0.5 ml SC) at 0, 7, 14 or 30 days >3 years: 3 doses (1.0 ml SC) at 0, 7, 14 or 30 days	3 years
Meningococcal meningitis, conjugate (Menactra)	>11 years	1 dose (0.5 ml i.m.)	None recommended to date
Meningococcal meningitis, polysaccharide	>2 years	1 dose (0.5 ml s.c.)	Boost after 2–3 years if first dose was given before 4 years old
Plague vaccine	>18 years	Not for use in children	
Rabies vaccine	Any age	3 doses (1 ml i.m., deltoid (or anterolateral thigh in infants), or 0.1 ml i.d.) at 0, 7, 21 or 28 days	Only HDCV approved for intradermal (i.d.) use
Typhoid, Ty21a[b], oral	>3 years[a]	3 doses: 1 sachet p.o. in 100 ml water every other day	Liquid vaccine[a] booster: 7 years
	>6 years	4 doses: 1 capsule p.o. every other day	Capsule vaccine booster: 5 years
Typhoid, Vi polysaccharide, parenteral	>2 years	1 dose (0.5 ml i.m.)	Boost after 2 years for continued risk of exposure
Yellow fever[b]	>9 months	1 dose (0.5 ml s.c.)	10 years; see text

[a]Not approved in the USA. Available in Canada and Switzerland.
[b]Caution, may be contraindicated in patients with any of the following conditions: pregnancy, leukemia, lymphoma, generalized malignancy, immunosuppression resulting from HIV infection or treatment with corticosteroids, alkylating drugs, antimetabolites, or radiation therapy.
[c]See manufacturer's package insert for recommendations on dosage.

itinerary. Consideration for vaccination should be given to the availability of rabies immune globulin in case post-exposure prophylaxis is needed. The initial treatment of animal bites with soap and water first aid measures must be emphasized, along with the importance of obtaining post-exposure rabies prophylaxis within 24 h.

A tuberculosis (TB) skin test is recommended for children before, if the TB status is unknown, and after extended travel in tropical and developing countries. BCG vaccine administration in the USA is controversial. Some advocate its use for infants <1 year old if high-risk travel to rural, endemic areas is planned. BCG vaccine

TABLE 12.4 Vaccine interactions

Vaccine	Interaction	Precaution
Measles-Mumps-Rubella (MMR) vaccine and varicella vaccine	Immune globulin or other antibody containing blood products	Give vaccines at least 2 weeks before immune globulin (IG), or 3–11 months after IG, depending on dose and product received.
Oral typhoid vaccine	Antibiotics	Delay vaccine administration at least 24 h after antibiotics.[a]
Virus vaccines, live (MMR, OPV, Varicella, yellow fever vaccine)	Other live virus vaccines	Give live virus vaccines on the same day, or separate the doses by at least 28 days.
Virus vaccines, live (MMR, OPV, Varicella, yellow fever vaccine)	Tuberculin skin test (PPD)	Do the skin test before or on the same day as receipt of a live virus vaccine, or 4–6 weeks after: virus vaccines can impair the response to the PPD skin test.
Varicella	Salicylates	Avoid salicylates 6 weeks after vaccine due to theoretical risk of Reye's syndrome

[a]These recommendations are based on theoretical considerations; efficacy studies are in progress. (From: CDC. Health information for international travel 2008.)

decreases the incidence of TB meningitis in this age group. Official USA recommendations for BCG vaccine administration are limited to (1) continuous exposure to an untreated or ineffectively treated person with infectious TB or multidrug-resistant (MDR) TB when the child cannot be removed from the environment, or (2) healthcare workers in settings of a high percentage of MDR TB and an unsuccessful TB control program. It is contraindicated in immune-deficient persons.

MALARIA PREVENTION

Personal Protective Measures

Protecting the traveling child from insect bites will decrease exposure to malaria and other serious infections spread by biting insects. Many insect-borne infections, including malaria, dengue fever, encephalitis, filarial diseases, leishmaniasis, trypanosomiasis, and cutaneous myiasis, are not vaccine-preventable, so minimizing exposure is critical.

Malaria is transmitted by biting female *Anopheline* mosquitoes, which feed mainly between the hours of dusk and dawn. The risk of exposure to malaria in an infant or child can be greatly reduced by the following maneuvers: (1) limit outdoor exposure during the hours between dusk and dawn; (2) wear protective clothing that covers most of the body when outdoors (a hooded 'bug suit' that covers head, arms, body, and legs can be made out of mosquito netting, or is commercially available); (3) use DEET-containing (diethyltoluamide) insect repellent of ≤35%, sparingly, on exposed areas of skin when outdoors (see Chapter 5); (4) spray a permethrin-containing insecticide on external clothing (see Chapter 14); and (5) sleep under a permethrin-impregnated mosquito net at night (see Chapter 6). The use of permethrin-impregnated bednets has been studied in many rural malarious areas, with a dramatic decrease in the transmission of malaria, even when chemoprophylaxis is not being used.

The active ingredient in recommended mosquito repellants is DEET. DEET has been approved by the Environmental Protection Agency (EPA) for use in humans, but with specific warnings and directions. Child safety claims were removed from labeling in 1998. Brief exposure, following the label directions, is not believed to pose a health concern. DEET is recommended for use in children at concentrations of ≤35%. Although extremely rare, reported toxicities include seizures, subacute encephalopathy, and local skin or eye irritation. Advise parents to apply it sparingly, avoiding the palms, and do not allow children to handle it directly. It should not be applied under clothing and should be washed off once indoors. A patch test on the antecubital fossa can identify children with skin sensitivity. Combination DEET/sunscreen products have not received EPA approval pending further assessment of potentially unnecessary DEET exposures. Specific EPA updates can be obtained at the website: http: www.epa.govpesticides and at the National Pesticide Information Center at Tel: 1-800-858-7378. If using both products, apply the sunscreen product to the skin first, then the insect repellent.

Some insect repellants containing citronella, lemon eucalyptus, and neem oil, and the Avon bath oil, Skin-so-Soft, have been shown to have some limited effectiveness as repellants but no significant action against the *Anopheles* mosquito that transmits malaria. Their use is not recommended for insect protection when traveling to malarious areas.

The scratching of mosquito bites also predisposes children to impetigo in the tropics.

Chemoprophylaxis

Drug choices to prevent malaria in children are similar to those available for adults, with specific weight and formulations caveats. Chloroquine is used to prevent chloroquine-sensitive malaria. Chloroquine can be used in any sized infant; however, its pill form makes dosing small infants difficult. Splitting pills is cumbersome for certain child weights and often requires pre-weighing and packaging by a pharmacist. Chloroquine can be obtained abroad as a pediatric suspension, but is not available in the USA or Canada in this form. An alternate drug is hydroxychloroquine (Plaquenil), which offers the same protection in chloroquine-sensitive areas as does chloroquine. In the USA, hydroxychloroquine is significantly less expensive than chloroquine.

Mefloquine, the drug used for prevention of chloroquine-resistant malaria, is given to children using a weight-adjusted dose. It is currently recommended for use in infants of any size. Contraindications to the use of mefloquine (seizure disorders, cardiac conduction defects, and neuropsychiatric disorders) are identical to those for adults. Doxycycline should not be used in children <8 years old due to dental staining. The fixed-drug combination, atovaquone/proguanil is highly effective as chemoprophylaxis against chloroquine malaria, and may be used in infants weighing >5 kg.

Primaquine phosphate is used for eradication of latent incubating *Plasmodium vivax* or *Plasmodium ovale* malaria parasites in the liver after intense exposure in endemic areas (Table 12.5 and Chapter 6).The glucose-6-phosphate dehydrogenase level must be checked prior to prescribing primaquine, as it is a potent red blood cell oxidizer in those who have inadequate or deficient levels of this enzyme present. No studies have been done on loading doses of antimalarials in children, and such practices are not recommended in pediatric age groups at this time. A summary of antimalarial drugs and pediatric dosing is found in Table 12.5.

TABLE 12.5 Drugs used for malaria chemoprophylaxis in children

Drug	Weight (kg)	Dose	Comments
Chloroquine phosphate (Aralen)[a]	Any	8.3 mg/kg per week (salt) = 5 mg/kg(base); max 500 mg/week (salt), 300 mg/week (base)	Use 250 mg tablets if available; very bitter; liquid preparation available in some countries
Hydroxychloroquine sulfate (Plaquenil)[a]	Any	6.5 mg/kg per week (salt) = 5 mg/kg (base); max 400 mg/week (salt), 310 mg/week (base)	200 mg tablet; liquid preparation may be available
Mefloquine (Lariam)[a]	<9	5 mg/kg per week	250 mg tablet; no liquid form available
	10–19	¼ tablet q. week	
	20–30	½ tablet q. week	
	31–45	¾ tablet q. week	
	>45	1 tablet q. week	
Atovaquone/proguanil (Malarone)[b]	5–8	½ pediatric tablet	62 mg atovaquone and 25 mg proguanil pediatric tablet
	8–10	¾ pediatric tablet	
	10–20	1 tablet/day	
	20–30	2 tablets/day	
	30–40	3 tablets/day	
	>40	4 tablets (1 adult tablet)/day	
Doxycycline (Vibramycin, Daryx, others)[c]	Any	2 mg/kg/day, up to 100 mg/day	100 mg tablet; contraindicated in <8 years old
Primaquine phosphate	Any	0.5 mg/kg salt = 0.3 mg/kg base daily×14 days	26.3 mg (15 mg base) tablet; must check G6PD status; postexposure terminal prophylaxis for *P. vivax*

G6PD, Glucose-6-phosphate dehydrogenase.
[a]Start 1 week before entering malarious area and continue 4 weeks after returning.
[b]Start 1–2 days before entering malarious area and continue 7 days after returning.
[c]Start 1–2 days before entering malarious area and continue 4 weeks after returning.

Children <6 years old usually have difficulty swallowing pills. Parents of the traveling child can purchase a 'pill splitter' available in many pharmacies. After splitting a mefloquine or chloroquine tablet into the appropriate-size pieces, the tablet fragment can be crushed to a fine powder with the back of a spoon or with a 'pill crusher' also available in many pharmacies. The correct dose of powdered medication can then be mixed into a spoonful of chocolate syrup or jelly (to mask the bitter taste) and given to the child. For older children, the portion of a crushed pill can be embedded in a candy bar, cream filled sandwich cookie or other sweet food. For infants weighing between 5 and 10 kg, one-quarter of a tablet can be finely crushed and mixed in a measured aliquot (10 mL) of breast milk or formula. The calculated milliliter dose can then be given by syringe, with the remainder being discarded.

Alternatively, if the correct dose for weight is calculated and prescribed, a pharmacist can pulverize the medication and dispense the proper weekly dose

(with the addition of inert filler) into capsules. The capsules can be opened up and suspended into a spoonful of chocolate syrup for the weekly dose. Enteric-coated tablets of chloroquine (500 mg) are difficult to crush and prepare. Generic chloroquine phosphate tablets (250 mg), if available, lend themselves more readily to pediatric preparations.

Antimalarial drugs are not secreted in the breast milk at therapeutic levels, so nursing infants of mothers taking antimalarials must also be given appropriate chemoprophylaxis. Parents should be warned that antimalarial drugs are extremely toxic and that the tablets should be stored in childproof containers out of reach of small children. Ingestion of one 500 mg (salt) tablet of chloroquine resulted in death of a 12-month-old toddler. Chloroquine overdose in children has a reported 80% mortality rate.

Drug dosing for standby therapy of malaria in children can be found in Table 12.6. The treatment with atovaquone/proguanil should be given if not on this drug for prophylaxis. The lower weight limit for treatment dosing is 5 kg. Parents should be urged to seek medical evaluation of any ill child and not to treat this potentially life-threatening disease without medical guidance. Discussing availability of medical care while away is an important aspect of the pre-travel visit.

DIARRHEA PREVENTION AND TREATMENT

Prevention of diarrhea in children is especially important during travel in hot, tropical climates, since children rapidly become dehydrated during diarrheal illnesses. Safe food and water selection is the same as for travelers in general, and is outlined in Table 7.2 and discussed in detail in Chapter 7. Breast milk is ideal for the traveling infant. Other milk should be boiled, pasteurized, or irradiated. Ultra-high temperature labeled milk, sterilized by flash heating to 137°C for 2–4 s, is also an available alternative that does not require refrigeration until opening. In addition to preventing diarrheal illness, meticulous attention to safe food and water selection will also decrease exposure to intestinal parasites. The worldwide burden of *Ascaris* and hookworm is carried mainly by children through ingestion of these pathogens. Hand-washing, especially before eating, nail trimming, and wearing shoes are simple ways to interrupt transmission of these common parasites. The use of alcohol-based hand sanitizer is encouraged.

Preventing dehydration by oral rehydration with appropriate fluids is the first-line treatment of diarrhea in children. The World Health Organization's recipe for

TABLE 12.6 Drugs used for presumptive self-treatment of malaria in children

Medication	Weight (kg)	Dose[a]
Atovaquone/proguanil	5–8	2 pediatric tablets
	9–10	3 pediatric tablets
	11–20	1 adult tablet
	21–30	2 adult tablets
	31–40	3 adult tablets
	>41	4 adult tablets

[a]Once daily dose for 3 consecutive days. (Adapted from CDC 2008.)

oral rehydration solution (ORS) is recommended. The molecular basis for ORS relies on a 1:1 ratio of sodium to glucose transport at the intestinal epithelial level. A powdered formula is commercially available in inexpensive foil packages that can be suspended in 1 L of purified water to yield the correct solution (see Chapter 8). Cereal-based oral rehydration therapy is also available. The rice cereal base offers a lower osmolarity and provides continued nutrition during the illness. Once the starch base is absorbed, twice the amount of glucose is released to promote intestinal reabsorption of electrolytes. In patients with cholera, the cereal-based ORS has been shown to provide clinically significant reductions in 24-h stool output compared with standard ORS. In acute, non-choleric diarrhea, the effect is less pronounced. ORS should be used in place of milk-based formula and other fluids until the child is fully recovered from the initial dehydration phase of the illness. One half to 1 cup of ORS is recommended for each diarrheal stool passed in a 10 kg child. Practical recommendations for giving the required volume of ORS include using a syringe or a spoon, adding pre-sweetened drink mix as some of the glucose source for both the color and flavor, and making it into frozen treats. The only contraindications to ORS are intractable vomiting, ileus, and abnormal level of consciousness. Slow and steady administration of oral fluids to the vomiting child avoids overdistention of the stomach. Parental education regarding early signs of dehydration (decreased urine output and tears) and quantities of ORS to use is an important part of counseling about travelers' diarrhea (TD).

Recommendations regarding medications used for prevention and treatment of pediatric TD differ from those for adults. Bismuth subsalicylate (BSS) and antibiotics are not recommended for prevention of TD in pediatric patients. BSS may be considered for symptomatic treatment of watery diarrhea in infants and small children. It should be avoided if fever or bloody diarrhea is present. The use of BSS is contraindicated in persons with aspirin allergy. It should not be used in children and teenagers who have varicella or influenza, or who have had recent exposure, because of the theoretical risk of Reye's syndrome. Each tablespoon (15 mL) of commercial BSS suspension (Pepto-Bismol) contains 130 mg of salicylate. Several studies have reported that relief of diarrhea was safely obtained in hospitalized infants and young children with a weight-adjusted dose of BSS equal to 100–150 mg/kg per day given orally in five doses for up to 5 days without adverse side-effects. Both the salicylate and the bismuth levels were well below toxic ranges.

Antimotility medications (loperamide, diphenoxylate) are not recommended in infants or young children. One investigation on the use of loperamide at the standard dosage (0.2 mg/kg per day) in infants and young children did not show a statistically significant difference in duration or outcome of illness when compared to placebo. In another study, high-dose loperamide (0.8 mg/kg per day) was shown to reduce stool output in hospitalized infants. Adverse central nervous system events, abdominal distention, and ileus have been reported in infants and young children taking loperamide. This evidence precludes routine recommendation for its use as a self-administered medication in children <6 years old. Because it is readily available to parents over the counter, discussion of its indications and side-effects is warranted in pre-travel counseling. Loperamide may be considered for occasional use in older children if symptoms of dysentery are absent and a prolonged journey is necessary.

Bulking agents, such as kaolin and pectin have little effect on overall disease and are not recommended. Probiotics including various species of the genus *Lactobacillus* have studied for their effect in children with favorable results. Antibiotic associated

diarrhea and viral diarrhea have been shown to be reduced to varying degrees by probiotics. The US Food and Drug Administration does not currently regulate these supplements, thus precise dosing and recommendations have not been published to date. The exact role of these supplements in traveling children has not been delineated, but it points to an interesting direction in diarrhea intervention.

Safety and efficacy influence antibiotic treatment of TD in infants and young children. Choices for treatment in children differ slightly from those for adults. The antibiotics that are considered safe for pediatric use are not necessarily effective against some of the emergent drug-resistant strains of bacterial pathogens implicated in TD (Chapter 7). Azithromycin is considered first choice for pediatric traveler's diarrhea. Quinolones are approved by the US Food and Drug Administration (FDA) for use in children <18 years old for specific infections (resistant urinary tract and bone infections). While experience with quinolones in children has not borne out the potential risk of the joint toxicity seen in experimental animals, widespread recommendations on using this class of drugs in children have not been made. Many advocate that the benefits of a 3-day course of quinolones for children with travelers diarrhea outweigh the risks for this potentially severe disease. Nalidixic acid, a non-fluorinated quinolone, has a long history of use in children for urinary tract infections. It is used in many countries for pediatric TD and is effective against some strains of *E. coli and Shigella* resistant to other drugs. Arthropathy has not been reported in children taking nalidixic acid. However, it has the same theoretical contraindications as fluoroquinolones, and is not approved by the FDA for use in children <18 years old unless the potential benefit justifies the risk. Obtaining informed consent is recommended if quinolones are prescribed for pediatric patients.

Given these constraints, a practical recommendation is to prescribe a therapeutic course of azithromycin in the travel medical kit for first-line antibiotic treatment of pediatric diarrhea. There have been no studies done to date to evaluate the duration of treatment needed for pediatric traveler's diarrhea. A 3-day course of treatment using 10 mg/kg per day is standard practice. Instituting therapy in children with frequent diarrheal stools while away is recommended. Fever and bloody stools necessitate antibiotic treatment as well. If a second-line drug is deemed necessary because of allergy, ciprofloxacin should be considered. For areas of *Campylobacter* predominance, azithromycin is preferable. Alternatively, parents should be informed that if prompt improvement after first-line treatment does not occur, medical evaluation is indicated. The proposed treatment plan should be discussed in detail with the parents. Any medications prescribed should be labeled with the indication for use. Families should be instructed to seek medical care for the child with severe dehydration, vomiting that prevents oral rehydration, fever lasting >24 h (especially in malarious areas), grossly bloody stools, and symptoms that continue or become worse. Empiric antibiotic treatment of infants >2 months can be considered, though young infants require a conservative approach with medical evaluation early in the illness. Febrile infants <2 months old should have an urgent medical evaluation and are thus not candidates for empiric antibiotic treatment of diarrhea while traveling.

Dietary energy intake improves nutritional outcome in pediatric diarrheal disease. Early enteral feeding stimulates intestinal cell renewal. Parents can continue breast-feeding or restart full strength lactose-free or lactose-reduced formula in bottle-fed infants as soon as rehydration has occurred. Cow's milk products should be reintroduced gradually. The incidence of true post-diarrheal lactose intolerance varies. Severe rotaviral illness is the pediatric enteritis most likely to be associated

with lactose intolerance and malabsorption, with rates reported as high as 60–80%. Most infants with mild-to-moderate rotaviral illness can return directly to cow's milk-based formula. The 'BRAT' diet: bananas, rice, applesauce and toast, has traditionally been advised for diarrheal illness, despite the lack of protein and energy. No evidence exists that this restrictive diet is necessary or advantageous for diarrhea treatment. Starches, cereals, yogurt, fruits, meats and low-fiber vegetables are good alternatives. Foods high in simple sugars and fats should be avoided in favor of complex carbohydrates until intestinal recovery has occurred.

Diaper dermatitis is an under recognized complication of diarrhea in young infants. Discomfort, pain and parental and child distress accompany this condition. Alert parents to be prepared with barrier cream (zinc oxide and petrolatum) for use on raw diaper areas. Hydrocortisone 1% can be used sparingly on broken down skin in the diaper area. Anti-fungal cream is often necessary for secondary yeast dermatitis. Pustular rashes may need local anti-bacterial coverage. Prepare for frequent diaper changes and cool compresses if rashes become severe with frequent stooling. Avoid commercially available diaper wipes and use paper towel or cloth with liquid soap to ease the sting of cleaning sensitive diaper areas.

GENERAL SAFETY FOR TRAVELING CHILDREN AND ADOLESCENTS

In many developing countries, the car seat will need to be fastened to the automobile or bus seat for the small child who will do extensive land travel. A nylon webbing strap or a length of climbing rope should be taken along to use with the car seat.

Accidental poisoning occurs commonly at home, even with close supervision, and increased vigilance is needed during travel. Contents of the travel medical kit, particularly anti-malarial medications, are potential sources of poisoning when a toddler explores a new environment. All medications should be kept in childproof containers and out of the reach of small children. New accommodations need careful inspection to make sure that contact with matchbooks, chemicals, cleaning solutions, and insecticide pads or coils can be supervised at all times, or that these items are removed from easy access. Poisonous plants should be removed from easy reach. Electrical outlet covers should be used. Supervision around swimming pools is vital.

All travelers to tropical and developing countries need advice about rabies prevention. The natural curiosity and friendliness that many children have toward animals should be discussed with parents. Children should be monitored closely to prevent animal contact while traveling. Older children should be warned to be cautious with all animals. Animal bites, particularly dog bites, in tropical and developing countries warrant medical attention. Monkey bites may transmit rabies and macaque bites may expose the child to simian herpes virus, a potentially fatal infection. In addition to the physical trauma and risk of bacterial wound contamination, rabies infection is of primary concern.

ALTITUDE

Children who accompany their parents to high-altitude destinations are at risk of developing altitude-related illnesses. The diagnosis of altitude illness is more difficult to recognize in young children. Non-specific symptoms that cannot be verbalized, like irritability, anorexia, and headache, mark the onset of potential altitude illness. Rapid decent is critical if any questionable illness or behavioral change occurs.

Several studies have shown that infants and young children born at sea level are perhaps more at risk of high altitude pulmonary edema than adults. Viral respiratory illnesses appear to increase this risk. Children with chronic lung disease, cardiac lesions with increased pulmonary blood flow, or sickle cell disease have been shown to have a predisposition to develop altitude illness. Children with Down's syndrome are particularly vulnerable to altitude illness, especially pulmonary edema.

Precautions against altitude illness in children are identical to those for adults: acclimatization by slow ascent and sleeping at altitudes below maximum daily altitudes. If air travel to altitude precludes slow acclimatization, rest and avoidance of dehydration and over exercise in the early stages of the trip are best advised. Preventive medications, such as acetazolamide, have not been conclusively studied in children. For children who have demonstrated past acute mountain sickness or who are traveling to a high altitude location with out the ability to slowly acclimatize (i.e., flying to LaPaz , Bolivia or Cuzco, Peru), a weight-adjusted dose of acetazolamide (5 mg/kg per day divided b.i.d.) can be considered. Likewise, there are no data on the use of pharmaceuticals to treat mountain sickness in children.

Infantile sub-acute mountain sickness is a distinct clinical entity that has been described in a small group of infants and young children several months after relocating from sea level to Tibet. Muscular hyperplasia of the pulmonary vascular bed occurs in an unpredictable subset of these children. The resultant pulmonary hypertension and right heart failure are severe enough to cause death. It is thought to be a complete failure of acclimatization.

MISCELLANEOUS ISSUES FOR YOUNG TRAVELERS

Children are vulnerable to the cumulative effects of sun exposure and damage. Lifetime risk of malignant melanoma and non-melanoma skin cancers is related to sun exposure that occurs before the age of 18 years. Sunburns in childhood magnify the risk. Avoiding mid-day exposure, when the sun is strongest, is recommended. Clothing and brimmed hats are the first lines of defense. Clothing made from tightly woven fabric that absorbs ultraviolet light is available commercially. Standard clothing, however, affords considerable protection. Sunscreens with a sun protection factor (SPF) of ≥15 should be used on exposed skin. SPF 15 provides 93% protection from ultraviolet B rays, whereas SPF 30 provides almost 97%. Sunblocks containing zinc oxide or titanium dioxide offer the advantage of a physical barrier, rather than chemical protection. Any sunscreen should be applied liberally to children >6 months at least 30 min before exposure. While infants <6 months should be covered while sun exposed, sunscreen use is safe. Re-application is necessary every 2 h or less frequently with waterproof varieties. Waterproof sunscreens are effective for at least 80 min in water. When traveling overseas, advise bringing an adequate supply of sunscreen, should it be unavailable while away. Sunglasses that block ultraviolet rays are also recommended to protect the retinas of children's eyes.

A suggested medical kit for travel with children is found in Table 12.7. Any essential medications, especially for asthma, anaphylaxis, or chronic disease, should be labeled and carried on board the airplane. Any child with a chronic disease should have a visit with the regular provider before travel. Children with asthma need to update their asthma management plan. It is advisable to review the management of asthma exacerbations and carrying an adequate supply of inhalers and steroids in case of emergency. Evacuation insurance is a prudent purchase for all travelers, since medical evacuations are not a standard part of US health plans.

TABLE 12.7 Recommended medical kit for travel with children

Medical card with age, weight, any important medical history, allergies, blood type, if known
immunization records
Over-the-counter medications:
- Acetaminophen
- Ibuprofen
- Antihistamine (e.g., diphenhydramine)
- 1% hydrocortisone cream
- Cough suppressant
- Antibacterial skin ointment
- Bismuth subsalicylate/loperamide, depending on age
- Antifungal cream

Prescription medications:
- Any regularly taken, with adequate supply
- Antibiotic treatment dose for traveler's diarrhea
- Antimalarial medication, if indicated

Consider:
- Antibiotic if child has recurrent otitis
- Injectable epinephrine kit, if history or severe allergic reaction to insect stings or foods
- Antibiotic eye drops
- Medication for motion sickness, if susceptible

First aid supplies/miscellaneous:
- Thermometer, safety pins, colorful adhesive bandages, ACE wrap
- Sunscreen, lip balm
- Disposable wipes
- Oral rehydration salts – pre-packaged
- Mosquito repellant
- Povidone iodine solution

For wilderness adventures, add:
- Thermal reflective blanket
- SAM splint

FURTHER READING

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