Preparing Children for International Travel

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PRACTICE GAPS

1. Pediatricians may be unfamiliar with agents that are most effective for antimalarial prophylaxis for a young infant traveler.
2. Pediatricians may not realize that measles-mumps-rubella and hepatitis A vaccines are recommended for infant travelers 6 months and older.

OBJECTIVES *After completing this article, readers should be able to:*

1. Select the most appropriate antimalarial prophylaxis agent according to high-risk regions.
2. Use insect bite prevention strategies to prevent malaria, dengue, and other vector-borne diseases.
3. Recognize which vaccines are necessary for the young pediatric traveler.

INTRODUCTION

Traveling with a child can be emotionally and educationally rewarding but challenging as well. Children are traveling from North America and Europe to most parts of the world, including Sub-Saharan Africa, Asia, and Central and South America. The most common reasons to travel are for leisure and to visit friends and relatives. (1) Children also accompany their families for pilgrimages, study abroad experiences, and parental work. Older children and adolescents travel as part of educational tours and humanitarian mission trips. Similar to adults, children traveling to potentially high-risk regions of the world expose themselves to risks of acquiring malaria, dengue, and diarrheal diseases. These diseases, followed by dermatologic conditions such as cellulitis, bites, and cutaneous larva migrans, are among the most common problems observed in pediatric travelers. Travelers visiting friends and relatives are at a greater risk because most do not visit travel clinics for advice or immunizations. (2)(3) They also tend to visit more remote parts of high-risk countries and stay for longer durations. Although at-risk children may not visit a travel clinic, they may be seen by their primary care health provider. Pediatricians, through setting expectations for parents and answering their questions, play an important role in providing a safer and more comfortable travel experience. Those who attend a specialized travel medicine clinic may do so too close to departure to receive necessary immunizations or may refuse recommended vaccines. Because of this possibility and not having enough time to visit a travel

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ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
DEET N	N-diethyl-m-toluamide
HACE	high-altitude cerebral edema
HAI	high-altitude illness
HAPE	high-altitude pulmonary edema
MenACWY	meningococcal quadrivalent conjugate vaccine
MMR	measles-mumps-rubella
PCR	polymerase chain reaction
TD	traveler's diarrhea

clinic, it is imperative that clinicians become familiar with travel-specific health recommendations and resources where this type of information can be accessed. This review article provides a comprehensive summary of pediatric travel medicine recommendations and resources as useful for primary care providers.

SAFETY AND COMFORT

Setting expectations and educating parents can greatly contribute to a safer and more comfortable flight for the whole family. Air travel is generally safe for healthy term infants and children. Special counseling should be given to parents of preterm infants and children with chronic pulmonary or cardiac diseases. Infants with ongoing respiratory ailments such as lower respiratory tract infections and asthma exacerbations should consider rescheduling travel. Travel to higher altitudes may place these infants at harm. Fitness-to-fly assessments (to simulate in-flight hypoxia) may be needed before departure, especially in infants and children with known cardiac and pulmonary conditions. (4)(5)(6) These are generally performed in pulmonary function laboratories by pediatric pulmonary specialists in children's hospitals.

Unrestrained children, especially during meal service or turbulence, are at risk for in-flight injuries. This is especially so for children occupying aisle seats because they are vulnerable to falling objects, aisle traffic, and burns from hot objects. (7)(8) Although incidents are rare, parents need to be informed of these risks so that they can take precautions. It is imperative that parents and caregivers childproof dwellings where they will reside during travel while also looking for small objects and needles left in bed linen or covers as well as under beds and chairs. Small children may swallow or aspirate these objects and cause a medical emergency. Televisions and heavy objects on dressers and tables need to be examined carefully for stability, especially when drawers are open. Glass doors to balconies need to be securely closed to avoid entry onto the balcony.

Child restraint is an important component of air travel. The Centers for Disease Control and Prevention (CDC) recommends placing children in Federal Aviation Administration–approved car seats, rear-facing if their age is younger than 1 year and they weigh less than 20 lb (9 kg) and forward-facing for those 1 year and older and 20 to 40 lb (9–18 kg). (9) Children who weigh more than 40 lb (18 kg) can use an airplane seatbelt.

Sedation of a child on a flight is not usually recommended, but diphenhydramine is used by some parents. Parents are advised to try a test dose at home first because some children will experience a paradoxical reaction with agitation and excitement. Benzodiazepines have the potential to cause respiratory depression, especially with inaccurate dosing in children, so they should not be used in children. Although recommended by some specialists, many experts suggest that chloral hydrate should also be avoided due to unpredictable responses and potential adverse effects in children.

Ear pain is a problem that some children may encounter on a flight, especially during descent and to a lesser extent on takeoff. Parents are advised to have their baby suck on a bottle or pacifier during these times and to have older children chew, swallow, yawn, or do the Valsalva maneuver if needed. A question frequently asked by parents to pediatricians is whether it is safe for a child with an ear infection to travel in an airplane. Unfortunately, studies to answer this question are lacking. Some have recommended delaying travel if possible. If travel dates are not flexible and the child is diagnosed as having a recent episode of otitis media, providing the child with proper analgesia may be warranted. At the same time, a middle ear that is full of fluid (whether infected or not) may be less likely to expand and contract with air pressure changes than an air-filled middle ear and, thus, less likely to become painful with ascent and descent.

Motion sickness can occur in children during travel. Children younger than 5 years may develop gait abnormalities, especially ataxia. Older children have signs and symptoms similar to those seen in adults with motion sickness, including generalized discomfort, pallor, drowsiness, headache, epigastric discomfort, nausea, and vomiting. Potential interventions to prevent motion sickness include eating a light meal a few hours before travel time, sitting in the front seat of a car if age permits, stabilizing the head, and focusing on a stable object. Antihistamines such as diphenhydramine and dimenhydrinate can be tried when preventive measures fail. Scopolamine is an option in children older than 12 years.

High-altitude illness (HAI) is a term that includes a variety of syndromes: acute mountain sickness, high-altitude cerebral edema (HACE), and high-altitude pulmonary edema (HAPE). These illnesses are usually associated with ascent to altitudes of 8,200 to 11,500 feet (2,500–3,500 m) or more. Symptoms can be subtle and nonspecific, especially in younger children, who may present with irritability or changes in their sleep pattern, activity, or appetite. Some children might experience HAPE, but the more life-threatening HACE is extremely rare in children. The risk of developing HAI is decreased by slow ascent to high altitudes. Mild symptoms are managed with rest, proper hydration, and analgesics such as ibuprofen. If symptoms are severe, immediate descent is advised. Acetazolamide is a medication that can be used for

prevention of acute mountain sickness. It is relatively safe and used in other conditions, but it has not been studied in children for the prevention of HAI. The dose is 5 mg/kg divided twice daily, with a maximum dose of 125 mg orally twice daily. It is usually started 1 day before ascent and continued for 2 days during a high-altitude stay once the desired altitude is reached. Children who develop HAPE should descend immediately and then subsequently be evaluated for structural heart disease and pulmonary hypertension. (10)

TRAVELER'S DIARRHEA

Traveler's diarrhea (TD) in children is associated with significant morbidity. Young children are most susceptible and frequently require replacement fluids and at times medical attention. (11)(12) TD in children can sometimes result in changes in travel itineraries. Although mostly used to define TD in adult travelers, TD in children can be defined as a twofold or greater increase in the frequency of unformed stools for at least 2 to 3 days. (13)(14) Additional symptoms may include abdominal cramps, nausea, vomiting, tenesmus, or fecal urgency during travel or on return. Dysentery, an inflammation in the intestinal mucosa secondary to invasion by a pathogen, is usually associated with fever and/or bloody stools. TD may be graded as mild (tolerable, not interfering with activities), moderate (distressing, interfering with activities), or severe (debilitating, preventing any activity, or dysentery). TD often starts in the first week of travel. Symptoms resolve within 48 hours in approximately half of affected patients.

TD is one of the most frequently encountered illnesses among travelers from high-income to middle- or low-income countries. The incidence is variable by destination, with the highest rates in North and Tropical Africa, Western and South Asia, and Central America. (15) Type of travel and duration of stay play a role in the rates of TD. The rates of TD are usually 50% or less if the stay is shorter than 2 weeks. Backpackers tend to consume more street food and unsafe water and, thus, have higher rates. Travelers visiting friends and relatives are at risk because they often travel without seeking pretravel advice and are more likely to ingest untreated contaminated local foods and beverages.

Preventing TD is essential when traveling with young children. Ice and street vendor food need to be avoided. Emphasis on hand hygiene is a must. Breastfeeding should be continued throughout the trip in infants who are breastfeeding. Foods should be well-cooked. Raw vegetables and fruits should be avoided, unless fruits can be peeled. Bottled or previously boiled beverages should be consumed and also used to take pills and to brush teeth. Bottled water should be purchased from established stores and not from street vendors. Carefully examining the seal before opening the bottle is essential to ensure that the plastic seal is intact.

TD is usually caused by bacterial pathogens. Bacteria encountered most frequently in TD are diarrheagenic strains of *Escherichia coli*; the most common are enterotoxigenic *E coli* and enteroaggregative *E coli*, followed by *Campylobacter* spp, *Shigella* spp, and *Salmonella* spp. (13) Viral pathogens include norovirus and rotavirus. Parasites such as *Giardia intestinalis* are responsible for protracted diarrhea. *Cryptosporidium* spp usually cause a self-limited diarrheal illness.

Most episodes of TD are self-limiting and do not need diagnostic testing. Although standard stool cultures can be useful in detecting some enteric bacteria, such as *Salmonella*, *Shigella*, and *Campylobacter*, molecular assays such as polymerase chain reaction (PCR) are needed to distinguish between pathogenic and nonpathogenic strains of *E coli*. Syndromic panel multiplex PCRs have higher sensitivity than standard stool cultures for common enteric pathogens and are useful in diagnosing viral and protozoal enteric infections. (16) PCRs are of greater utility when travelers have severe or persistent diarrhea and negative cultures. However, diagnostic testing is expensive and not readily available during travel, but it could be useful in the returned traveler with persistent gastrointestinal symptoms.

Adequate *hydration* should be provided to every child with TD. Commercial oral rehydration solutions with adequate amounts of glucose and electrolytes are administered frequently in small amounts, with a teaspoon if necessary. Appropriately made homemade solutions can also be used. Intravenous solutions are necessary in cases of severe dehydration when oral rehydration is not tolerated or not sufficient to correct the deficits. Breastfeeding should be continued if possible. Use of undiluted fruit drinks, sodas, and sport drinks should be discouraged. These fluids contain large amounts of glucose, which is likely to worsen the diarrhea, and contain too few electrolytes for appropriate rehydration and replacement of losses. Oral rehydration solutions can be part of a travel medical kit for parents with small children.

Antibiotics have been used effectively to treat TD in adults, but studies in children are lacking. Antibiotics are not routinely used in children with mild TD but are reserved for moderate to severe cases. Antibiotics play a role in reducing the severity and duration of TD, which, in turn, decreases the need for intravenous fluids and hospitalization. Azithromycin, 10 mg/kg per dose, is the first-line antibiotic to use in children with TD. It is generally safe and well-tolerated. It also works for fluoroquinolone-resistant *Campylobacter*

infections that are common in South and Southeast Asia. Fluoroquinolones are frequently prescribed for adults with TD, except for travel to South and Southeast Asia, where resistance is an issue. A single dose of antibiotic is generally sufficient for adults with TD, especially when administered with loperamide. If symptoms persist, a daily dose of antibiotic can be given for up to 3 days. There is no evidence that similar antibiotic dosing would not work in children with TD. Because of the potential of adverse reactions in children, fluoroquinolone use should be limited to circumstances when an alternative agent is not available and a suspected susceptible pathogen is likely. (17) In recent years, studies in travelers returning from South Asia who have received antibiotics for treatment of TD have found a high colonization rate with multiply-resistant *Enterobacteriaceae*, organisms that have led to other infections after returning home. (18) Some of the antibiotics commonly prescribed for diarrheal illness during travel and pediatric and adult dosing are listed in Table 1.

Antidiarrheal agents such as loperamide are used in adults to decrease the amount of stool output associated with TD. Use of loperamide for TD in children remains controversial. Although it is licensed for use in children 2 years and older, loperamide has significant adverse effects, including central nervous system depression and toxic megacolon and is generally not recommended. Children with bloody stool or fevers should not use loperamide. *Probiotics* have not been proven to be efficacious for TD, thus are not recommended. *Zinc* supplementation, despite its benefit in diarrheal illness in children in developing countries, is not recommended for treating TD in children who are less likely to have pre-illness zinc deficiency.

Dehydration with electrolyte imbalances can occur in children with TD. Long-term complications of TD include postinfectious irritable bowel syndrome, as well as reactive arthritis, hemolytic uremic syndrome, and Guillain-Barré syndrome.

Chemoprophylaxis is not routinely recommended. However, it could be considered for a child with a preexisting gastrointestinal condition such as inflammatory bowel disease or a malabsorption disorder. Such use should consider the risks of acquisition of multidrug-resistant organisms and the potential for developing an infection caused by *Clostridioides difficile*. No vaccine is available in the United States to protect from TD. An inactivated oral *Vibrio cholerae* whole cell/B subunit vaccine (Dukoral®, SBL Vaccin AB, Stockholm, Sweden), which is licensed in Canada, may offer some protection against heat-labile enterotoxin–producing *E coli* in travelers.

INSECT BITE PREVENTION

The use of insect repellents is an important and simple measure to reduce the risk of insect bites and prevent insect-borne illnesses. Insects such as mosquitoes, ticks, and flies are responsible for spreading illnesses such as malaria, Zika, Chikungunya, dengue, yellow fever, and rickettsial diseases.

N,N-*diethyl*-m-*toluamide (DEET)* and picaridin are the most effective repellents against mosquito bites. Products with less than 10% concentration are effective for approximately 1 to 2 hours, and a concentration of approximately 30% may last for approximately 5 hours. Concentrations between 25% and 30% are frequently recommended for visits to tropical regions. Concentrations of DEET higher than 50% do not confer greater protection. DEET is also effective against ticks and some flies. Use of concentrations of 20% or greater on exposed skin is recommended to protect against tick bites. DEET is safe in children older than 2 months when properly applied. (19) Rashes have been reported. Toxic encephalopathy has been seen with improper use or ingestion of DEET in children. DEET may damage clothes and eyeglasses.

Picaridin at a concentration of at least 20% protects well against mosquitoes but less so against ticks, fleas, chiggers, and flies, and it is equivalent to DEET. It is odorless and causes less skin irritation than DEET. At 20% it protects for approximately 8 hours.

Oil of lemon eucalyptus is found in the lemon eucalyptus plant. It is minimally effective against mosquitoes and flies,

TABLE 1. Antibiotics Commonly Prescribed for Self-treatment of Diarrheal Illness

MEDICATION	PEDIATRIC DOSE	ADULT DOSE
Azithromycin	10-mg/kg single daily dose, 1–3 d	1,000-mg single daily dose, 1–3 d
Ciprofloxacin[a]	10–15 mg/kg per dose twice daily, 1–3 d	1,000-mg single daily dose, 1–3 d
Levofloxacin[a]	10 mg/kg once daily, 1–3 d	500 mg daily, 1–3 d
Rifaximin	Not available	200 mg 3 times daily

[a]Not currently approved by the US Food and Drug Administration for use in children, but clinical studies supporting safety and efficacy have been published and dosing guidelines are available. (17)

but not as much against ticks compared with DEET. It is not to be used in children younger than 3 years.

Citronella provides short-lived (~20 minutes) protection against mosquito bites and is not effective for ticks. It is not recommended for use in the tropics.

The use of combination products containing an insect repellent and sunscreen is not recommended. *Sunscreen* needs to be applied more frequently. Use of a combination product may lead to greater exposure to DEET, especially at times when insect repellents are not needed. Separate products can be used together. It is recommended to apply sunscreen before insect repellents, keeping in mind that this reduces the effective sun protection factor of sunscreen. Application of insect repellents before sunscreen is not recommended because it may increase absorption of the repellent. *Wristbands* with chemical repellents and backyard *bug zappers* are not recommended because of limited efficacy.

Permethrin, a contact insecticide, can be applied on clothing, bed nets, and sleeping bags. Travelers should sleep in screened or air-conditioned dwellings at night. Permethrin-impregnated mosquito nets are effective in preventing malaria. Caution is recommended with the use of repellent coils as they can be a fire hazard and the smoke can be harmful to young children. Electric coils may be available in some countries. There is no strong data that electric coils prevent malaria.

MALARIA CHEMOPROPHYLAXIS

Medications should be prescribed to children for chemoprophylaxis when traveling to areas with malaria. It is important to explain to families that medication chemoprophylaxis does not prevent infection but rather works to prevent disease by killing the parasite after it leaves the liver. Thus, compliance to complete the period of prophylaxis is vital. Factors such as weight, age, ability to swallow tablets, and medication frequency and availability influence the choice of medications selected for pediatric travelers. The choice of antimalarial chemoprophylaxis agent is determined mostly by the presence of resistance to chloroquine. In addition, frequency of dosing and potential for adverse effects are major determinants. Unfortunately, these agents are not available in liquid form. Tablets need to be cut and crushed for young children. At times, smaller doses for younger infants need to be compounded by a pharmacy and placed into small sachets or gel caps for easier and more precise dose delivery These medications are known to cause gastrointestinal discomfort when taken on an empty stomach. Although most children tolerate these medications well, additional adverse effects have been reported. (20) Abnormal dreams, anxiety, insomnia, and depressed mood may be disturbing to some parents and children receiving mefloquine. The weekly dosing of this agent makes it an attractive choice for prophylaxis. Persons with a history of depression, anxiety, seizures, and cardiac conduction problems should avoid the use of mefloquine. Agents such as atovaquone-proguanil may be preferred, even when they require daily administration. It is rare that a child has to stop an agent because of adverse effects. Medications used for malaria prophylaxis are summarized in Table 2. Up-to-date information on recommended malaria prophylaxis for at-risk countries and regions can be found at the CDC Travel Health (Yellow Book) website (https://wwwnc.cdc.gov/travel/).

IMMUNIZATIONS

Vaccine-preventable illnesses are highly prevalent in international destinations, thus it is important to ensure that traveling families, especially children, are up-to-date in their routine immunizations. Some children may benefit from an accelerated schedule depending on the risk in the destination area. The most recent recommendations on routine immunizations and catch-up schedules are accessible on the American Academy of Pediatrics and CDC websites. Routine immunizations against illnesses such as measles-mumps-rubella (MMR), hepatitis A, and meningococcus require special attention. Additional destination-specific immunizations may be needed, (21) including typhoid fever, rabies, yellow fever, and Japanese encephalitis virus vaccines. Table 3 summarizes most immunizations needed before travel.

Measles is still epidemic in many countries, including several in Europe. Monovalent measles vaccine is not available in the United States. In the current immunization schedule, MMR vaccine is routinely administered at 12 to 15 months and 4 to 6 years. Traveling children who received their first MMR vaccine at 12 to 15 months of age should receive a second MMR vaccine at least 28 days apart from the first vaccine to ensure vaccine effectiveness because 7% of children might not respond after 1 dose. The second vaccine will complete their MMR series and they will not need additional doses at 4 to 6 years. Children 6 to 11 months of age should receive the MMR vaccine if traveling outside the United States. This early dose does not replace the subsequent routinely scheduled doses of MMR vaccine.

Hepatitis A is a viral illness that is highly prevalent in lower-resource countries. Hepatitis A vaccine is routinely given in the United States at 1 year of age, with a second dose 6 months later. Children are known to easily transmit the virus to older individuals, in whom the disease could be more serious. Infants 6 months and older should be vaccinated

TABLE 2. Summary of Antimalarial Prophylaxis Regimens

MEDICATION	PEDIATRIC DOSE	ADULT DOSE	COMMENTS
Chloroquine	8.3 mg/kg of salt (5.0 mg/kg of base) weekly, up to a maximum adult dose of 500 mg of salt	500-mg salt (300-mg base) tablet, 1 tablet weekly	Start at least 1 wk before arrival at risk site. Continue for 4 wk after leaving malaria region. Must take with food. Smaller doses for young children require compounding by pharmacy.
Hydroxychloroquine	6.5 mg/kg of salt (5.0 mg/kg of base) once weekly, up to a maximum adult dose of 400 mg of salt	400 mg of salt (310 mg of base)	Start ≥1 wk before arrival at risk site. Continue for 4 wk after leaving malaria region. Alternative to chloroquine.
Atovaquone-proguanil	**62.5/25-mg pediatric tablet:** 5–8 kg: 1/2 tablet once daily >8–10 kg: 3/4 tablet once daily >10–20 kg: 1 tablet once daily >20–30 kg: 2 tablets once daily >30–40 kg: 3 tablets once daily >40 kg: 1 adult tablet once daily	250/100-mg adult tablet**:** 1 tablet daily	Start 1–2 d before arrival in malaria region. Take for 7 d after departure. Take with food.
Mefloquine	**Dose given weekly:** ≤9 kg: 5 mg/kg of salt (4.6 mg/kg of base) 10–19 kg: 1/4 tablet 20–30 kg: 1/2 tablet 31–45 kg: 3/4 tablet >45 kg: 1 tablet	250-mg salt (228-mg base) tablet, 1 tablet weekly	Start at least 2 wk before arrival at risk site. Continue for 4 wk after leaving malaria region. Must take with food.
Doxycycline	Age ≥8 y: 2.2 mg/kg daily Maximum dosage, 100 mg daily	100-mg tablet One tablet daily	Start 1–2 d before arrival in malaria region. Continue for 4 wk after departure. Must take with food and plenty of fluids. Sunscreen advisable.
Primaquine	**Terminal prophylaxis** (antirelapse therapy): 0.8 mg/kg of salt form (0.5 mg/kg of base) once daily for 14 d after departure from malarious area **Short-term prophylaxis** for regions with predominantly *Plasmodium vivax*; begin 1–2 d before travel to malarious areas, continue for 7 d after leaving area	**Terminal prophylaxis** (antirelapse therapy): 26.3-mg salt (15-mg base) tablets; 2 tablets once daily for 14 d after departure from malarious area **Short-term prophylaxis** for regions with predominantly *P vivax*; begin 1–2 d before travel to malarious area, continue for 7 d after leaving area	**Terminal prophylaxis** to reduce risk for relapses by *P vivax* and *Plasmodium ovale*. Must confirm glucose-6-phosphate dehydrogenase sufficiency before administration.
Tafenoquine	Not recommended	150-mg tablets; age ≥16 y: 2 tablets, single dose	**Terminal prophylaxis** to reduce risk of relapses by *P vivax* and *P ovale*. Must confirm glucose-6-phosphate dehydrogenase sufficiency before administration.

with hepatitis A virus vaccine. Immune globulin injections would interfere with MMR vaccination. Some experts do not believe that immune globulin injections are warranted in young infants because hepatitis A is a relatively mild and usually asymptomatic infection in younger children. However, immune globulin injections can be used as protection. (22)(23)

Meningococcal quadrivalent conjugate vaccine (MenACWY) is routinely administered to adolescents in the United States at 11 to 12 years old, with a booster dose at age 16 years. Children traveling to high-risk destinations such as the meningitis belt in sub-Saharan Africa during the dry season (December–June) should receive the vaccine at an earlier age. The meningococcal vaccine is also required for entry to Saudi Arabia for religious visits such as Hajj or Umrah. MenACWY-tetanus toxoid and MenACWY-CRM are conjugate meningococcal vaccines that can be administered to children as young as 2 years and 2 months of age, respectively. MenB vaccine is not routinely recommended for children traveling to the meningitis belt region or other countries because meningococcal B disease is not prevalent in this region.

Typhoid vaccine is recommended for children traveling to areas with increased risk of exposure to *Salmonella enterica* serotype *typhi*. Travelers should be informed that the vaccine is not 100% protective and advised to follow proper hygiene and food and water precautions even when vaccinated. (24)(25) The vaccine is available in 2 formulations in the United States: the oral live attenuated vaccine and the intramuscular capsular polysaccharide vaccine.

Rabies virus, which causes a rapidly progressive fatal encephalomyelitis, is prevalent in many areas worldwide. It is important to educate travelers on the importance of preexposure vaccination, avoidance of animal bites, and

TABLE 3. Travel Vaccinations

VACCINE	FORMULATION	ROUTE AND DOSE	SCHEDULE	INDICATIONS	COMMENT
Hepatitis A Havrix® **Pediatric** (GlaxoSmithKline)	Injectable, 720 EU	IM, 0.5 mL	**Primary series:** 2 doses, 6–18 mo apart. **Booster:** Currently not recommended.	Children age ≥1–18 y. Infants age ≥6 mo should be vaccinated if visiting a country at high risk for hepatitis A. Two additional doses will still be required after first birthday.	Inactivated vaccine. Lifelong protection is likely.
Hepatitis A VAQTA® **Pediatric** (Merck)	Injectable, 25 U	IM, 0.5 mL	**Primary series:** 2 doses, 6–18 mo apart. **Booster:** Currently not recommended	Children age ≥1–18 y. Infants age ≥6 mo should be vaccinated if visiting a country at high risk for hepatitis A. Two additional doses will still be required after first birthday.	Inactivated vaccine. Lifelong protection is likely.
Hepatitis A Havrix® **Adult** (GlaxoSmithKline)	Injectable, 1,440 EU	IM, 1.0 mL	**Primary series:** 2 doses, 6–18 mo apart. **Booster:** Currently not recommended.	Adults age ≥19 y.	Inactivated vaccine. Lifelong protection is likely.
Hepatitis A VAQTA® **Adult** (Merck)	Injectable, 50 U	IM, 1.0 mL	**Primary series:** 2 doses, 6–18 mo apart. **Booster:** Currently not recommended.	Adults age ≥19 y.	Inactivated vaccine. Lifelong protection likely.
Hepatitis A and B Twinrix® (GlaxoSmithKline)	Injectable	IM, 1.0 mL	**Primary series:** 3 doses at 0, 1, and 6 mo. **Accelerated schedule:** 0, 7, and 21 d; fourth dose 12 mo later. Booster not needed.	Adults age ≥18 y.	Inactivated vaccine. Lifelong protection is likely. Accelerated schedule is as effective as routine schedule but requires a 4th dose.
Immune globulin, human GamaSTAN S/D® (Grifols Therapeutics Inc) (21)(22)	Injectable	IM, see schedule	**Preexposure prophylaxis:** Up to 1 mo of travel: 0.1 mL/kg Up to 2 mo of travel: 0.2 mL/kg 2 mo of travel or longer: 0.2 mL/kg (repeat every 2 mo).	No maximum dosage for hepatitis A prophylaxis.	Hepatitis A vaccine is preferred as preexposure protection against hepatitis A virus. Immune globulin may be indicated for infants <6 mo of age.
JEV Ixiaro® (Valneva USA, Inc.)	Injectable	IM, 2 mo to <3 y: 0.25 mL; ≥3 y: 0.5 mL	**Primary series:** 2 doses at days 0 and 28. **Accelerated schedule:** 2 doses at days 0 and 7. **Booster:** 1 dose 1 y later if exposure to JEV expected.	Travel to high-risk areas. Prolonged stays anticipated or shorter stays during rainy seasons.	Booster dosing in children is well-tolerated and is immunogenic. (26)

Continued

TABLE 3. (Continued)

VACCINE	FORMULATION	ROUTE AND DOSE	SCHEDULE	INDICATIONS	COMMENT
MMR	Injectable	SC	**Primary series:** 12–15 mo of age. Second dose is recommended ≥28 d after first dose.	Routine vaccination and for infant travelers age ≥6 mo.	In the United States, routine vaccination takes place at age 12–15 mo with a second dose at school entry (age 4–6 y). Infant travelers age ≥6 mo should receive a single dose of MMR. Two additional doses will still be required after first birthday. Ideally, older children age <4 y should receive second MMR before travel if 28 d after first dose.
Meningococcal conjugate quadrivalent, ACWY-tetanus toxoid: Menquadfi® (Sanofi Pasteur)	Injectable	IM, 0.5 mL	**Persons ≥2y:** 1 dose.	Routine vaccination in United States at age ≥11–12 y with recommended booster 5 y later.	Required for entry to Saudi Arabia during the Hajj. Recommended for travelers visiting meningitis belt in sub-Saharan Africa during dry months. This vaccine should not be used in infants age <9 mo because it may interfere with antibody production by pneumococcal conjugate vaccine.
Meningococcal conjugate quadrivalent, ACWY-CRM: Menveo® (GlaxoSmithKline)	Injectable	IM, 0.5 mL	**Children initiating vaccination at age 2 mo:** Doses at 2, 4, 6, and 12 mo. **Children starting vaccination at age 7–23 mo:** 2 doses, with second dose after age 2 y.	Routine vaccination in United States at age ≥11–12 y with recommended booster 5 y later.	Required for entry to Saudi Arabia during the Hajj. Recommended for travelers visiting meningitis belt in sub-Saharan Africa during dry months.

Continued

TABLE 3. (Continued)

VACCINE	FORMULATION	ROUTE AND DOSE	SCHEDULE	INDICATIONS	COMMENT
Rabies Inactivated human diploid cell vaccine Imovax® (Sanofi Pasteur/ Novartis) Purified chicken embryo cell vaccine RabAvert® (Sanofi Pasteur/Taleris)	Injectable	IM, 1.0 mL	**Preexposure series:** 2 doses at days 0 and 7. **Booster:** Depends on risk category. Booster 21 days: 3 years after primary doses. Alternative: serological testing 2 years after initial doses. Booster if titers undetectable. **Postexposure:** Rabies immune globulin; day 0 (20 IU/kg) with vaccines at days 0, 3, 7, and 14. A 5th dose is recommended if host is immunocompromised.		Consider for young travelers planning prolonged stays, especially away from large urban centers with adequate medical care systems and airport. Young toddlers are at an increased risk for rabies and are candidates for vaccination.
Typhoid fever Polysaccharide Vi Antigen Inactivated	Injectable	IM, 0.5 mL	**Primary series:** 1 dose. **Booster:** every 2 y.	Persons age ≥2 y.	
Typhoid fever Ty21a Live attenuated	Oral	1 capsule per dose	**Primary series:** 1 capsule every other day for 4 doses. **Boosters:** Every 5 y.	Persons age ≥6 y.	If series sequence not completed, all 4 doses need to be repeated. Contraindicated in immunocompromised hosts. Cannot be taken with hot beverages. Person must not be taking antibiotics. Capsules must be swallowed whole. Cannot be opened, chewed, or crushed.

Continued

TABLE 3. (Continued)

VACCINE	FORMULATION	ROUTE AND DOSE	SCHEDULE	INDICATIONS	COMMENT
Yellow fever Live attenuated vaccine	Injectable	SC, 0.5 mL	**Primary series:** 1 dose. Dose must be given ≥10 d before arrival to risk area. **Booster:** No longer required by WHO. **US travelers:** Recommended every 10 y for high-risk travelers.	Persons age ≥9 mo.	Contraindicated in immunocompromised hosts. Avoid in pregnancy and in breastfeeding mothers, unless high-risk travel cannot be avoided. Contraindicated in infants age <4 mo. Avoid in persons with thymus disorders. **Infants age 6–8 mo:** Consider vaccination with caution if risk of travel cannot be avoided. Consult travel medicine specialist. Caution in persons age ≥60 y (high risk for vaccine-related infection). Requires official certificate of vaccination.US-produced yellow fever vaccine is not available in United States at this time. Specific vaccination centers have been designated by CDC for the administration of a French vaccine. Consult CDC yellow fever website for a center near you.

Abbreviations: CDC, Centers for Disease Control and Prevention; IM, intramuscular; JEV, Japanese encephalitis virus; MMR, measles-mumps-rubella; SC, subcutaneous; WHO, World Health Organization.

TABLE 4. General Recommendations for Travelers

• Safety and injury prevention: Use car seats, seat belts. Sit in the back seats. Never leave children unattended. Childproof all rooms. Inspect sliding doors and balconies. Inspect under beds and chairs.
• Pack a first aid kit. Keep all prescription medications in their original containers. Bring printed copies of pharmacy-provided information with generic names. Place all medications in carry-on hand luggage.
• Bring photocopies or digital photos of passports and birth certificates (especially for US-born children of expatriates): This makes replacement easier if original passport is lost or stolen.
• Avoid boredom: Bring cards, favorite books, games, movies, and snacks.
• Be careful crossing streets: Watch out for bikes, motorcycles, people, and vehicles in the left lane. Look both ways!
• Best seats for children on planes: Bulk head (more leg space). Bassinettes may be available. Your child will not bother anyone in the front.
• Ear discomfort: Provide child with something to drink or eat during ascent and descent.
• Avoid cutaneous larva migrans, other parasitic infections (hookworms): Do not walk barefoot on ground or dry sand. Use a towel at the beach or lay in the turf.
• Avoid swimming in fresh water in the tropics: this prevents schistosomiasis, intestinal parasitic infections, traveler's diarrhea, and hepatitis. Chlorinated pools are fine.
• Get medical and evacuation insurance (such as from International SOS, SafeTrip, Travelex, others).
• During long flights, get out of your seat and walk: Avoid "economy-class" thrombosis.
• Prevent high-altitude illness: Acclimatization is important. Acetazolamide can be used as prophylaxis. Consult someone familiar with acute mountain sickness.
• Waterfalls, rivers, streams (rafting, kayaking) in the tropics: High risk for leptospirosis. Doxycycline could be used as prophylaxis.

postexposure management of wounds and prophylaxis. Children have a higher risk of rabies exposure because they tend to be more attracted to animals, and the bites might involve higher-risk areas such as the face and head. Availability of rabies immune globulin and vaccines is limited in many countries, making preexposure vaccination more desirable when considering travel to high-risk regions. (26)

Yellow fever vaccine is a live attenuated vaccine recommended for all children 9 months and older traveling to endemic regions. Proof of vaccination is required for entry to some countries. It is sometimes advised to postpone travel if possible if a child is younger than 9 months. Yellow fever vaccine is contraindicated in children younger than 6 months because it has a higher risk of neurologic complications, such as vaccine-associated encephalitis. The vaccine should be considered, with precautions, in children 6 to 8 months old traveling to areas with yellow fever. For most travelers a single dose of yellow fever vaccine provides long-lasting protection, and a booster dose is not necessary. However, travelers to regions with ongoing outbreaks should consider receiving a booster dose if it has been 10 years or more since last being vaccinated.

Japanese encephalitis vaccine is recommended for all children, 2 months and older, who are traveling to areas endemic for Japanese encephalitis virus during the transmission

Table 5. Resources for Commonly Asked Pediatric Travel Questions

• CDC Travel Health (Yellow Book): https://wwwnc.cdc.gov/travel/
• CDC Vaccines (Vaccine Information Statements): https://www.cdc.gov/vaccines/index.html
• International Society of Travel Medicine: http://www.istm.org. Source for global travel clinic directory
• American Society of Tropical Medicine and Hygiene: https://www.astmh.org/education-resources/clinical-consultants-directory. Directory for tropical medicine and travelers' health consultants
• American Academy of Pediatrics. In: Kimberlin DW, Brady MT, Jackson MA, Long SS, eds. *Red Book: 2018 Report of the Committee on Infectious Diseases*. 31st ed. Itasca, IL: American Academy of Pediatrics; 2018.
• American Academy of Pediatrics. Choosing an insect repellent for your child. HealthyChildren.org website. https://www.healthychildren.org/English/safety-prevention/at-play/Pages/Insect-Repellents.aspx
• US State Department. Travel: https//travel.state.gov/content/travel/html. Source for travel advisories for US citizens.
• Kamat DM, Fischer PR, eds. *Textbook of Global Child Health*. 2nd ed. Itasca, IL, American Academy of Pediatrics; 2016.
• Keystone JS, Kozarsky PE, Connor BA, Nothdurft HD, Mendelson M, Leder K, eds. *Travel Medicine*. 4th ed. Philadelphia, PA: Elsevier; 2019.
• Zuckerman J, Brunette GW, Leggat P, eds. *Essential Travel Medicine*. Hoboken, NJ: Wiley-Blackwell; 2015.

season and staying for at least 1 month. (27) It is also recommended to give the Japanese encephalitis vaccine to individuals staying less than 1 month if they have plans for high-risk activities or itineraries or travel occurring during rainy seasons. The vaccine is safe and immunogenic in young children. (28)(29)(30)

ILLNESSES AFTER TRAVEL

Diarrheal and skin infections are among the most common travel-related ailments affecting pediatric travelers. Children with febrile infections such as malaria and typhoid fever are frequently severely ill, requiring hospitalization. (31)(32)(33) Most of these children did not receive proper antimalarial prophylaxis or appropriate vaccines or had not followed proper health and safety precautions. Clinicians must be attentive to the development of fever, skin lesions, and exanthems in returned travelers. Incubation periods in relation to duration of travel and time of return from travel have to be considered when evaluating the sick pediatric traveler. (13)

CONCLUSIONS

Preparing families with children for travel can result in safer, healthier, and more comfortable trips for the whole family. General travel recommendations are summarized in Table 4. Special advice should be given to traveling families on insect bite prevention, management of TD, malaria prophylaxis, and immunizations. Table 5 provides a list of some of the available resources for preparing travelers.

Summary

- Based on strong research evidence, diarrhea is a common problem in travelers visiting countries with lower economic resources and poor sanitary infrastructure. (11)(14)
- Based on strong research evidence, vaccination is an effective way to prevent travel-related infections such as hepatitis A, measles, rabies, and Japanese encephalitis virus encephalitis. (20)(22)(25)(26)
- Based on strong research evidence, travelers visiting friends and relatives are at a high risk for travel-related infections such as diarrhea, typhoid, and malaria. (1)(2)(3)

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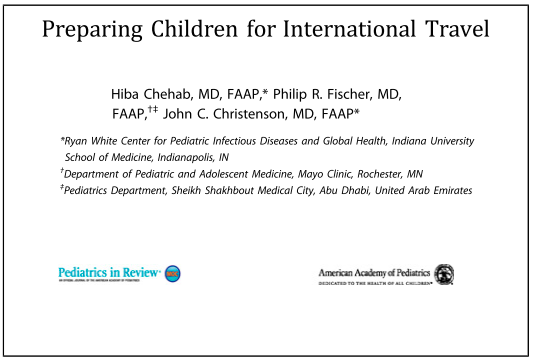
Preparing Children for International Travel

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1. A previously healthy 4-year-old girl is seen in the office for diarrhea. The family returned yesterday from a vacation in Jamaica. They did consume food on 2 occasions from a street vendor. The diarrhea started 4 days ago but is now much improved. No blood was noted. She did not have vomiting or fever. The girl appears well, and her physical examination findings are normal. Which of the following was the most likely pathogen?

   A. *Campylobacter hyointestinalis*.
   B. *Clostridium perfringens*.
   C. Enterotoxigenic *Escherichia coli*.
   D. *Shigella dysenteriae*.
   E. *Shigella flexneri*.

2. A healthy 9-month-old boy is seen in the office for a health supervision examination. The parents have no concerns but state that they are traveling to Bangladesh in 10 days to visit family for 2 weeks and are concerned that their baby will develop diarrhea. Which of the following is the most appropriate recommendation concerning traveler's diarrhea prevention or treatment for this infant?

   A. Azithromycin daily for the duration of the trip.
   B. Levofloxacin for 3 days if he develops diarrhea.
   C. Loperamide for 3 days if he develops diarrhea.
   D. Oral rehydration solution if he develops diarrhea.
   E. Probiotic daily for the duration of the trip.

3. A 9-year-old healthy girl is seen in the office for a sports physical to play soccer. Her father states that the girl is going on a photo safari to Tanzania with her parents in the summer. The father asks for recommendations concerning insect bite prevention. In addition to permethrin applied on clothing and use of permethrin-impregnated mosquito nets, which of the following is the most appropriate recommendation?

   A. Apply 30% DEET (*N,N*-diethyl-meta-toluamide) to exposed skin.
   B. Apply citronella to exposed skin.
   C. Apply a combination sunscreen and DEET product to exposed skin.
   D. Light an insect repellent coil at bedtime.
   E. Wear a wristband insect repellent.

4. A healthy 9-month-old girl is seen in the office for a health supervision visit. Her diet is human milk and age-appropriate packaged baby food. The parents have no current concerns. She is growing well, has normal development, and her physical examination findings are normal. Her immunizations are up-to-date. The parent's state that they are traveling to Romania in 3 weeks to visit family for 14 days. In addition to continuing her current diet, which of the following should be recommended at this visit?

   A. 23-Valent pneumococcal polysaccharide vaccine.
   B. Hepatitis A vaccine and measles-mumps-rubella vaccine.
   C. Intramuscular immune globulin and measles-mumps-rubella vaccine.
   D. Meningococcal B vaccine.
   E. Typhoid vaccine.

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5. A 7-year-old boy is brought to the office for a health supervision visit and to see whether he needs any immunizations. Mom states that the family will be traveling to Saudi Arabia in 6 weeks for the Hajj and will be out of the country for 16 days. The boy was up-to-date with his immunizations when he entered kindergarten and has received a yearly influenza vaccine. He has no health concerns, and his physical examination findings are normal. Which of the following immunizations is recommended at this visit?

   A. 23-Valent pneumococcal polysaccharide vaccine.
   B. Japanese encephalitis vaccine.
   C. Meningococcal quadrivalent conjugate vaccine.
   D. No additional vaccines are recommended.
   E. Tetanus, diphtheria, and pertussis vaccine.

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