Air Travel

Most commercial airlines allow pregnant travelers to fly until 36 weeks' gestation. Some limit international travel earlier in pregnancy, and some require documentation of gestational age. Pregnant travelers should check with the airline for specific requirements or guidance, and should consider the gestational age of the fetus on the dates both of departure and of return.

Most commercial jetliner cabins are pressurized to an equivalent outside air pressure of 6,000–8,000 ft (≈1,800–2,500 m) above sea level; travelers might also experience air pressures in this range during travel by hot air balloon or on noncommercial aircraft. The lower oxygen tension under these conditions likely will not cause fetal problems in a normal pregnancy. People with pregnancies complicated by conditions exacerbated by hypoxia (e.g., preexisting cardiovascular problems, sickle cell disease, severe anemia [hemoglobin <8.0 g/dL], intrauterine fetal growth restriction) could, however, experience adverse effects associated with low arterial oxygen saturation.

Risks of air travel include potential exposure to communicable diseases, immobility, and the common discomforts of flying. Abdominal distention and pedal edema frequently occur. The pregnant traveler might benefit from an upgrade in airline seating and should seek convenient and practical accommodations (e.g., proximity to the lavatory). Pregnant travelers should select aisle seating when possible, and wear loose fitting clothing and comfortable shoes that enable them to move about more easily and frequently during flights.

Some experts report that the risk for deep vein thrombosis (DVT) is 5–10 times greater among pregnant than nonpregnant people, although the absolute risk is low. To help prevent DVT, pregnant travelers should stay hydrated, stretch frequently, walk and perform isometric leg exercises, and wear graduated compression stockings (see Sec. 8, Ch. 3, Deep Vein Thrombosis & Pulmonary Embolism).

Cosmic radiation during air travel poses little threat to the fetus but might be a consideration for pregnant travelers who fly frequently (see Sec. 9, Ch. 3, . . . *perspectives*: People Who Fly for a Living—Health Myths & Realities). Older airport security machines are magnetometers and are not harmful to the fetus. Newer security machines use backscatter x-ray scanners, which emit low levels of radiation. Most experts agree that the risk for complications from radiation exposure from these scanners is extremely low.

Cruise Ship Travel

Most cruise lines restrict travel beyond 24 weeks' gestation (see Sec. 8, Ch. 6, Cruise Ship Travel). Cruise lines might require pregnant travelers to carry a physician's note stating that they are fit to travel, including the estimated date of delivery. Pregnant people should check with the cruise line for specific requirements or guidance. For pregnant travelers planning a cruise, provide advice about gastrointestinal and respiratory infections, motion sickness (see Sec. 8, Ch. 7, Motion Sickness), and the risk for falls on a moving vessel, as well as the possibility of delayed care while at sea.

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TRAVEL & BREASTFEEDING

Erica Anstey, Katherine Shealy

The medical preparation of a traveler who is breastfeeding differs only slightly from that of other travelers and depends in part on whether the breastfeeding traveler and child will be separated or together during travel. Most travelers should be advised to continue breastfeeding their children throughout travel.

Before departure, travelers might benefit from compiling a list of local breastfeeding resources at their destination, to have on hand during travel. Clinicians and travelers can use the Find a Lactation Consultant Tool (www.FindALactationConsultant.com) to find contact information for experts at their destination. Clinicians and travelers can use La Leche League International's interactive map (www.llli.org/get-help) to find specific location and contact information for breastfeeding support group leaders and groups worldwide. Travelers who will need to store expressed milk while traveling can call ahead to their hotel or other place of lodging to request access to a refrigerator, if available.

TRAVEL WITH A BREASTFEEDING CHILD

Breastfeeding provides unique benefits to children while traveling. Explain clearly to breastfeeding travelers the value of continuing to breastfeed during travel. The American Academy of Pediatrics (AAP) recommends exclusive breastfeeding for the first 6 months of life. Exclusive breastfeeding means feeding only breast milk, no other food or drink, which potentially protects children from contaminants and pathogens in foods or liquids. Additionally, feeding only at the breast protects children from potential exposure to contaminants on bottles, containers, cups, and utensils.

During the first 6 months, breastfeeding children require no water supplementation, even in extreme heat environments. Breastfeeding protects children from eustachian tube collapse and pain during air travel, especially during ascent and descent, by allowing them to stabilize and gradually equalize internal and external air pressure.

Frequent, unrestricted breastfeeding opportunities ensure that the lactating traveler's milk supply remains sufficient, and that the child's nutrition and hydration are ideal. Travelers concerned about breastfeeding away from home might feel more comfortable breastfeeding the child in a fabric carrier or by using a nursing cover. In many countries, breastfeeding in public places is practiced more widely than in the United States. US federal legislation protects parents' and children's rights to breastfeed anywhere they are otherwise authorized to be while on federal property, including US Customs areas, embassies, and consulates overseas. The Consolidated Appropriations Act, 2021, SEC. 722 states, "Notwithstanding any other provision of law, a woman may breastfeed her child at any location in a Federal building or on Federal property, if the woman and her child are otherwise authorized to be present at the location" (see www.congress.gov/116/bills/hr133/BILLS-116hr133enr.pdf).

TRAVEL WITHOUT A BREASTFEEDING CHILD

Before departure, a breastfeeding person might decide to express and store a supply of milk to be fed to the child during the traveler's absence.

Building a supply takes time and patience, and is most successful when begun gradually, many weeks in advance of departure. Clinicians and others who provide lactation support should help travelers determine the best course for breastfeeding based on a variety of factors, including the amount of time available to prepare for the trip, the flexibility of time while traveling, options for expressing and storing milk while traveling, the duration of travel, and destination.

While away from the child, expressing milk can help the breastfeeding traveler maintain milk supply for when they return home. Expressing milk also can help avoid engorgement, which can increase the risk of developing a breast infection. Expressing milk by hand is a useful technique to learn prior to traveling because it does not require any equipment or a reliable power source, and detailed instructions are available at https://healthychildren.org/English/ages-stages/baby/breastfeeding/Pages/Hand-Expressing-Milk.aspx. Hand expressing can be helpful when travelers need to express milk while in transit (e.g., on a bus, car, plane, train). Travelers intending to use breast pumps should plan to pack multiple breast pump kits if they anticipate being unable to clean individual pump parts after each use (see the section on breast pump safety later in this chapter). A nursing cover can provide some privacy when expressing milk.

Travelers who return to a nursing child can continue breastfeeding and, if necessary, supplement with previously expressed milk or infant formula until milk supply returns to its prior level. Often, after returning from travel, several days of feeding at the breast will help bring milk supply back to its prior level. Prolonged separation from the nursing child might, however, increase the difficulty and time it takes to transition back to breastfeeding. A lactation consultant can help address breastfeeding challenges after a traveler reunites with their child.

MEDICATIONS, VACCINES & OTHER EXPOSURES

In almost all situations, clinicians can and should select medications and vaccines for the nursing traveler that are compatible with breastfeeding. In most circumstances, it is inappropriate to counsel travelers to wean to be vaccinated, or to withhold vaccination due to breastfeeding status.

Breastfeeding and lactation do not affect maternal or child dosage guidelines for any medication or vaccine; children always require their own medications and vaccines, regardless of maternal dose. In the absence of documented risk to the breastfeeding child associated with a particular maternal medication, the known risks of stopping breastfeeding generally outweigh a theoretical risk for exposure via breastfeeding.

Drugs & Chemicals

According to the AAP 2013 Clinical Report: The Transfer of Drugs and Therapeutics into Human Breast Milk, many parents are inappropriately advised to discontinue breastfeeding or to avoid taking essential medications because of fears of adverse effects on their breastfed infants. Only a few medications are contraindicated in people who are breastfeeding or are associated with adverse effects on their children.

The National Institutes for Health's Drugs and Lactation Database (LactMed; www.ncbi.nlm.nih.gov/books/NBK501922) is an online source for clinical information about drugs and chemicals to which breastfeeding travelers could be exposed. LactMed provides information about the levels of substances in breast milk and infant blood, potential effects on breastfeeding children and on lactation itself, and alternative drugs to consider.

Another resource, Hale's Medications and Mothers' Milk, is a regularly updated pharmaceutical reference guide that provides comprehensive, evidence-based information on the compatibility or effects of >1,300 drugs, diseases, vaccines, herbals, and syndromes on breastfeeding, and includes risk categories, pharmacologic properties, interactions with other drugs, and suitable alternatives. An online version is available by subscription and is printable.

MotherToBaby (https://mothertobaby.org) is a service of the nonprofit Organization of Teratology Information Specialists (OTIS) and provides evidence-based information on the safety of or risk from medications and other exposures during pregnancy and lactation. OTIS provides a free information and risk assessment service to mothers, health care providers, and the

public via text, chat, phone, and email, in English and Spanish.

MALARIA CHEMOPROPHYLAXIS

Because chloroquine and mefloquine can be safely prescribed to infants, both are considered compatible with breastfeeding. Most experts consider short-term use of doxycycline compatible with breastfeeding. Primaquine can be used for breastfeeding people and for infants with normal glucose-6-phosphate dehydrogenase (G6PD) levels, but screen both for G6PD deficiency before prescribing this drug. Because data are not yet available on the safety of atovaquone-proguanil prophylaxis in infants weighing <11 lb (5 kg), the Centers for Disease Control and Prevention (CDC) does not recommend it to prevent malaria in people who are breastfeeding infants weighing <5 kg (see Sec. 5, Part 3, Ch. 16, Malaria, for more information).

The quantity of antimalarial drugs transferred to breast milk is not enough to provide protection against malaria for the infant. Breastfeeding infants need their own antimalarial drug. More information about malaria and breastfeeding is available at www.cdc.gov/breastfeeding/breastfeeding-special-circumstances/maternal-or-infant-illnesses/malaria.html.

TRAVELERS' DIARRHEA TREATMENT

Exclusive breastfeeding protects children against travelers' diarrhea (TD). Breastfeeding is ideal rehydration therapy. Children suspected of having TD should breastfeed more frequently and should not be offered other fluids or foods that replace breastfeeding. Breastfeeding travelers with TD should continue breastfeeding if possible, and increase their own fluid intake. The organisms that cause TD do not pass into breast milk.

Breastfeeding travelers should carefully check the labels of over-the-counter antidiarrheal medications to avoid using bismuth subsalicylate compounds, which can lead to the transfer of salicylate to the child via breast milk. Fluoroquinolones and macrolides, commonly used to treat travelers' diarrhea, are excreted in breast milk. Consult with the breastfed child's primary health care provider before deciding to prescribe antibiotics for breastfeeding travelers. Most experts consider the short-term use of azithromycin compatible with breastfeeding. Use of oral rehydration salts is fully compatible with breastfeeding.

Vaccinations

Vaccinate breastfeeding travelers and children according to routine, recommended vaccine schedules. Most live and inactivated vaccines do not affect breastfeeding, breast milk, or the process of lactation (see www.cdc.gov/breastfeeding/breastfeeding-special-circumstances/vaccinations-medications-drugs/vaccinations.html). Only 2 vaccines, smallpox (vaccinia) and yellow fever, require special consideration. Preexposure smallpox vaccine is contraindicated in breastfeeding people because of the risk for contact transmission to the breastfed child.

YELLOW FEVER VACCINE

Breastfeeding is a precaution against administering yellow fever vaccine. Three cases of yellow fever vaccine–associated neurologic disease (encephalitis) have been reported in infants exclusively breastfed by people who received yellow fever vaccine. All 3 infants were aged <1 month at the time of exposure.

Until specific research data are available, avoid vaccinating breastfeeding travelers against yellow fever. When a breastfeeding person must travel to a yellow fever endemic area, however, vaccination should be recommended. Although no data are available, some experts advise that breastfeeding travelers who receive yellow fever vaccine should temporarily suspend breastfeeding, and pump and discard milk for ≥2 weeks after vaccination before resuming breastfeeding (see Sec. 5, Part 2, Ch. 26, Yellow Fever, for more information). Refer the traveler to a lactation support provider for information on how to maintain milk production and how to best feed the child while not breastfeeding; options include using previously expressed milk, pasteurized donor human milk, infant formula, or a combination of these.

Zika Virus

CDC encourages people with Zika virus infection and those living in or traveling to areas with ongoing Zika virus transmission to breastfeed their children. Evidence suggests that the benefits

of breastfeeding outweigh the risks of Zika virus transmission through breast milk. Current information is available at www.cdc.gov/pregnancy/zika/testing-follow-up/zika-in-infants-children.html.

AIR TRAVEL

Air travel should not be a barrier to breastfeeding or expressing breast milk. Being prepared and aware of available resources can help ease anxiety about traveling by air with breast milk, breast pump equipment, or a breastfeeding child.

Breast Pump Equipment & Breast Milk

Before departure, people who will be traveling by air and expect to have expressed milk with them during travel need to carefully plan how they will transport the expressed milk. Airport security regulations for passengers carrying expressed milk vary internationally and are subject to change.

In the United States, expressed milk and related infant and child feeding items are exempt from Transportation Security Administration (TSA) regulations limiting quantities of other liquids and gels (see www.tsa.gov/travel/special-procedures/traveling-children). Travelers can carry with them expressed milk, ice packs, gel packs (frozen or unfrozen), pumps and pump kits, and other accessories required to transport expressed milk through airport security checkpoints and onboard flights, regardless of whether the breastfeeding child is also traveling. At the beginning of the screening process, travelers should inform the TSA officer that they are carrying breastfeeding equipment, and separate the expressed milk and related accessories from the liquids, gels, and aerosols that are limited to 3.4 oz (100 mL) each, as subject to TSA's Liquids Rule, available at www.tsa.gov/travel/security-screening/liquids-rule.

Breast pumps are medical devices regulated by the US Food and Drug Administration (FDA), and most airlines allow passengers to carry breast pumps on board in addition to other permitted carry-on items. Travelers can check the airline's policies related to breastfeeding and breastfeeding equipment prior to travel.

X-rays used in airport screenings have no effect on breastfeeding, expressed milk, or the process of lactation. FDA states that no adverse effects are known from eating food, drinking beverages, or using medicine screened by x-ray. Travelers also should inform the TSA officer if they do not want expressed milk to be opened or irradiated in scanners. TSA officers might conduct additional screening procedures (e.g., pat down, and screening of other carry-on property). Travelers should plan for extra time at the airport to get through the airport security checkpoints when traveling with expressed milk and related supplies. Travelers might find that providing TSA officers with the related TSA regulations for expressed milk (available at www.tsa.gov/travel/special-procedures/traveling-children) can help facilitate the screening process.

Travelers carrying expressed milk in checked luggage should refer to cooler pack storage guidelines on the CDC website, Proper Storage and Preparation of Breast Milk (www.cdc.gov/breastfeeding/recommendations/handling_breastmilk.htm). Expressed milk is considered a food for individual use, and is not considered a biohazard. International Air Transport Authority regulations for shipping category B biological substances (UN 3373) do not apply to expressed milk.

Lactation Spaces

By 2023, all small, medium, and large hub airports in the United States are required by the Friendly Airports for Mothers Improvement Act (www.congress.gov/bill/116th-congress/senate-bill/2638) to provide a clean, private, non-bathroom lactation space in each terminal for breastfeeding or expressing milk. Travelers can check the airport's website to locate these spaces.

Packing & Shipping Breast Milk

Travelers shipping frozen milk should follow guidelines for shipping other frozen foods and liquids. Travelers planning to ship frozen milk might need to bring supplies (e.g., milk storage bags or resealable bags; paper lunch bags or newspaper for wrapping frozen milk; coolers; labels, packing tape, and shipping boxes; tongs or gloves for handling dry ice). Some shipping carriers provide temperature-controlled options that can be used for transporting expressed milk. Some employers

will cover the cost of shipping expressed milk home for employees who are traveling for work. Travelers should make sure in advance that transporting expressed milk will meet customs regulations, because these can vary by country. Expressed milk does not need to be declared at US Customs upon return to the United States.

BREAST PUMP SAFETY

Travelers who plan to use an electric breast pump while traveling might need an electrical current adapter and converter, and should have a back-up option available, including information on hand expression techniques or a manual pump. Travelers using a breast pump should be sure to follow proper breast pump cleaning guidance (see www.cdc.gov/healthywater/hygiene/healthychildcare/infantfeeding/breastpump.html) to minimize potential contamination. Related guidance for cleaning infant feeding items (e.g., bottles and the nipples, rings, and caps that go with them) is available at www.cdc.gov/healthywater/hygiene/healthychildcare/infantfeeding/cleansanitize.html.

Travelers should thoroughly wash hands with soap and water (see www.cdc.gov/handwashing/when-how-handwashing.html) prior to pumping and handling expressed milk; if safe water is not immediately available, travelers can use an alcohol-based hand sanitizer containing ≥60% alcohol (www.cdc.gov/handwashing/hand-sanitizer-use.html). If travelers are unable to clean pump parts between uses, they should bring extra sets of pump parts (e.g., connectors, flanges, membranes, valves) to use until they are able to thoroughly clean used parts. Travelers also could consider packing a cleaning kit for breast pump parts, including a cleaning brush, dish soap, and portable drying rack or mesh bag to hang items to air dry.

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TRAVELING SAFELY WITH INFANTS & CHILDREN

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Children increasingly are traveling and living outside their home countries. Although data about the incidence of pediatric illnesses associated with international travel are limited, the risks that children face when traveling are likely similar to those faced by their adult travel companions.

Compared with adults, however, children are less likely to receive pretravel advice. In a review of children with posttravel illnesses seen at clinics in the GeoSentinel Global Surveillance Network, 51% of all children and 32% of children visiting friends and relatives (VFRs) had received pretravel medical advice, compared with 59% of adults. The most commonly reported health problems among child travelers are dermatologic conditions, including animal and arthropod bites, cutaneous larva migrans, and sunburn; diarrheal illnesses; respiratory disorders; and systemic febrile illnesses, especially malaria.

Motor vehicle and water-related injuries, including drowning, are other major health and safety concerns for child travelers. See Box 7-03 for recommendations on assessing and preparing children for planned international travel.

TRAVEL-ASSOCIATED INFECTIONS & DISEASES

Arboviral Infections

Pediatric VFR travelers with frequent or prolonged travel to areas where arboviruses (e.g., chikungunya, dengue, Japanese encephalitis, yellow fever, and Zika viruses) are endemic or epidemic could be at increased risk for infection. Children traveling to areas with arboviruses should use the same mosquito protection measures described elsewhere in this chapter (also see Sec. 4, Ch. 6, Mosquitoes, Ticks & Other Arthropods). Unlike

BOX 7-03 Assessing & preparing children for international travel: a checklist for health care providers

- ☐ Review travel-related and routine childhood vaccinations. The pretravel visit is an opportunity to ensure that children are up to date on their routine vaccinations.
- ☐ Assess all anticipated travel-related activities.
- ☐ Provide preventive counseling and interventions tailored to specific risks, including special travel preparations and any treatment required for infants and children with underlying health conditions, chronic diseases, or immunocompromising conditions.
- ☐ For children who require medications to manage chronic health conditions, caregivers should carry a supply sufficient for the trip duration.
- ☐ For adolescents traveling in a student group or program (see also Sec. 9, Ch. 8, Study Abroad & Other International Student Travel), consider providing counseling on the following:
  - ○ Disease prevention
  - ○ Drug and alcohol use
  - ○ Empiric treatment and management of common travel-related illnesses
  - ○ Risks of sexually transmitted infections and sexual assault
- ☐ Give special consideration to travelers visiting friends and relatives in low- and middle-income countries and assess risks for malaria, intestinal parasites, and tuberculosis.
- ☐ Consider advising adults traveling with children and older children to take a course in basic first aid before travel.
- ☐ For coronavirus disease 2019 (COVID-19) safety measures for children—including mask use, testing, and vaccination—see Sec. 5, Part 2, Ch. 3, COVID-19.

mosquitoes that transmit malaria, the *Aedes* mosquitoes that transmit chikungunya, dengue, yellow fever, and Zika are aggressive daytime biters; they also bite at night, especially in areas with artificial light. Consider dengue or other arboviral infections in children with fever if they recently returned from travel in endemic areas. Vaccination against dengue, tick-borne encephalitis, and yellow fever could be indicated for some children (see Sec. 7, Ch. 4, Vaccine Recommendations for Infants & Children, for details).

Diarrhea & Vomiting

Diarrhea and associated gastrointestinal illnesses are among the most common travel-related problems affecting children. Infants and children with diarrhea can become dehydrated more quickly than adults. The etiology of travelers' diarrhea (TD) in children is similar to that in adults (see Sec. 2, Ch. 6, Travelers' Diarrhea).

PREVENTION

Adults traveling with children should ensure the children follow safe food and water precautions and frequently wash their hands to prevent foodborne and waterborne illness. For infants, breastfeeding is the best way to reduce the risk for foodborne and waterborne illness (see Sec. 7, Ch. 2, Travel & Breastfeeding). Infant formulas available abroad might not have the same nutritional composition or be held to the same manufacturing safety standards as in the traveler's home country; parents feeding their child formula should consider whether they need to bring formula from home. If the infant is fed with formula, travelers should consider using liquid formula, which is sterile. Use of powdered infant formula has been associated with *Cronobacter* infection; infants <3 months old, infants born prematurely, and infants with weakened immune systems are at greatest risk. Parents should take extra precautions for preparing powdered infant formula (see www.cdc.gov/cronobacter/prevention.html).

Travelers should disinfect water served to young children, including water used to prepare infant formula (see Sec. 2, Ch. 8, Food & Water Precautions, and Sec. 2, Ch. 9, Water Disinfection, for details on safety practices). In some parts of the world, bottled water could be contaminated and should be disinfected to kill bacteria, viruses, and protozoa before consumption.

Similarly, travelers with children should diligently follow food precautions and ensure foods served to children are cooked thoroughly and eaten while still hot; caregivers should peel fruits typically eaten raw immediately before consumption. Additionally, adults should use caution with fresh dairy products, which might not be pasteurized or might be diluted with untreated water. For short trips, parents might want to bring a supply of safe snacks from home for times when children are hungry and available food might not be appealing or safe (see Sec. 2, Ch. 8, Food & Water Precautions, for more information).

Adult travelers with children should pay scrupulous attention that potable water is used for handwashing and cleaning bottles, pacifiers, teething rings, and toys that fall to the floor or are handled by others. After diaper changes, especially for infants with diarrhea, parents should be particularly careful to wash hands well to avoid spreading infection to themselves and other family members. When proper handwashing facilities are not available, hand sanitizer containing ≥60% alcohol can be used as a disinfecting agent. Because alcohol-based hand sanitizers are not effective against certain pathogens, however, adults and children should wash hands with soap and water as soon as possible. In addition, alcohol does not remove organic material, and people should wash visibly soiled hands with soap and water.

Chemoprophylaxis with antibiotics is not generally used in children; typhoid vaccine might be indicated, however (see Sec. 5, Part 1, Ch. 24, Typhoid & Paratyphoid Fever).

TREATMENT

ANTIBIOTICS

AZITHROMYCIN

Few data are available regarding empiric treatment of TD in children. Antimicrobial options for empiric treatment of TD in children are limited. In practice, when an antibiotic is indicated for moderate to severe diarrhea, some clinicians prescribe azithromycin as a single daily dose (10 mg/kg) for 3 days. Clinicians can prescribe unreconstituted azithromycin powder before travel,

with instructions from the pharmacist for mixing it into an oral suspension prior to administration. Although resistance breakpoints have not yet been determined, elevated minimum inhibitory concentrations for azithromycin have been reported for some gastrointestinal pathogens. Therefore, counsel parents to seek medical attention for their children if they do not improve after empiric treatment. Before prescribing azithromycin for empiric TD treatment, review possible contraindications and the risks for adverse reactions (e.g., QT prolongation and cardiac arrhythmias).

FLUOROQUINOLONES

Although fluoroquinolones frequently are used for empiric TD treatment in adults, these medications are not approved by the US Food and Drug Administration (FDA) for this purpose in children aged <18 years because of cartilage damage seen in animal studies. The American Academy of Pediatrics (AAP) suggests that fluoroquinolones be considered for treatment of children with severe infections caused by multidrug-resistant strains of *Campylobacter jejuni*, *Salmonella* species, *Shigella* species, or *Vibrio cholerae*.

Fluoroquinolone resistance in gastrointestinal organisms has been reported from some countries, particularly in Asia. In addition, use of fluoroquinolones has been associated with tendinopathies, development of *Clostridioides difficile* infection, and central nervous system side effects including confusion and hallucinations. Routine use of fluoroquinolones for prophylaxis or empiric treatment for TD among children is not recommended.

RIFAXIMIN

Rifaximin is approved for use in children aged ≥12 years but has limited use for empiric treatment since it is only approved to treat noninvasive strains of *Escherichia coli*. Children with bloody diarrhea should receive medical attention, because antibiotic treatment of enterohemorrhagic *E. coli*, a cause of bloody diarrhea, has been associated with increased risk for hemolytic uremic syndrome (see Sec. 5, Part 1, Ch. 7, Diarrheagenic *Escherichia coli*).

ANTIEMETICS & ANTIMOTILITY DRUGS

Antiemetics generally are not recommended for self- or family-administered treatment of children with vomiting and TD. Because of the association between salicylates and Reye syndrome, bismuth subsalicylate (BSS), the active ingredient in both Pepto-Bismol and Kaopectate, is not generally recommended to treat diarrhea in children <12 years old. In certain circumstances, however, some clinicians use it off-label, with caution. Care should be taken if administering BSS to children with viral infections (e.g., influenza, varicella), because of the risk for Reye syndrome. BSS is not recommended for children aged <3 years.

Use of antiemetics for children with acute gastroenteritis is controversial; some clinical practice guidelines include the use of antiemetics, others do not. A Cochrane Collaboration Review of the use of antiemetics for reducing vomiting related to acute gastroenteritis in children and adolescents showed some benefits with dimenhydrinate, metoclopramide, or ondansetron. Guidelines from the Infectious Diseases Society of America suggest that an antinausea and antiemetic medication (e.g., ondansetron) can facilitate tolerance of oral rehydration in children >4 years of age, and in adolescents with acute gastroenteritis.

A recent systematic review and network meta-analysis comparing several antiemetics in acute gastroenteritis in children showed that ondansetron was the best intervention to reduce vomiting and prevent hospitalization and the need for intravenous rehydration. Routine use of these medications as part of self-treatment for emesis associated with TD in children has not yet been studied, however, and is not generally recommended.

Antimotility drugs (e.g., the opioid receptor agonists loperamide and diphenoxylate), generally should not be given to children <18 years of age with acute diarrhea. Loperamide is particularly contraindicated for children aged <2 years because of the risks for respiratory depression and serious cardiac events. Diphenoxylate and atropine combination tablets should not be used for children aged <2 years, and should be used judiciously in older children because of potential side effects (see Sec. 2, Ch. 6, Travelers' Diarrhea).

FLUID & NUTRITION MANAGEMENT

The biggest threat to an infant with diarrhea and vomiting is dehydration. Fever or increased ambient temperature increases fluid loss and accelerates dehydration. Advise adults traveling with children about the signs and symptoms of dehydration and the proper use of oral rehydration solution (ORS). Advise adults traveling with children to seek medical attention for an infant or young child with diarrhea who has signs of moderate to severe dehydration, bloody diarrhea, body temperature >101.3°F (38.5°C), or persistent vomiting (unable to maintain oral hydration). Adequate hydration is the mainstay of TD management.

ORAL REHYDRATION SOLUTION: USE & AVAILABILITY

Counsel parents that dehydration is best prevented and treated by ORS in addition to the infant's usual food. While seeking medical attention, caregivers should provide ORS to infants by bottle, cup, oral syringe (often available in pharmacies), or spoon. Low-osmolarity ORS is the most effective agent in preventing dehydration, although other formulations are available and can be used if they are more palatable to young children. Homemade sugar-salt solutions are not recommended.

Sports drinks are designed to replace water and electrolytes lost through sweat, and do not contain the same proportions of electrolytes as the solution recommended by the World Health Organization for rehydration during diarrheal illness. Drinks with a high sugar content (e.g., juice, soft drinks) can worsen diarrhea. If ORS is not readily available, however, offer children whatever safe liquid they will take until ORS is obtained. Breastfed infants should continue to breastfeed (for more details, see Sec. 7, Ch. 2, Travel & Breastfeeding).

ORS can be made from prepackaged glucose and electrolytes packets available at stores or pharmacies in almost all countries. Some pharmacies and stores that specialize in outdoor recreation and camping supplies also sell ORS packets.

ORS is prepared by adding 1 packet to boiled or treated water (see Sec. 2, Ch. 9, Water Disinfection). Advise travelers to check packet instructions carefully to ensure that the contents are added to the correct volume of water. Once prepared, ORS should be consumed or discarded within 12 hours if held at room temperature, or within 24 hours if kept refrigerated. A dehydrated child will usually drink ORS avidly and should continue to receive ORS if dehydration persists.

As dehydration lessens, the child might refuse the salty-tasting ORS, and adults can offer other safe liquids. An infant or child who has been vomiting will usually keep ORS down if it is offered by spoon or oral syringe in small sips; adults should offer these small sips frequently, however, so the child can receive an adequate volume of ORS. Older children will often drink well by sipping through a straw. Severely dehydrated children often will be unable to drink adequately. Severe dehydration is a medical emergency that usually requires administration of fluids by intravenous or intraosseous routes.

In general, children weighing <22 lb (10 kg) who have mild to moderate dehydration should be administered 2–4 oz (60–120 mL) of ORS for each diarrheal stool or vomiting episode. Children who weigh ≥22 lb (10 kg) should receive 4–8 oz (120–240 mL) of ORS for each diarrheal stool or vomiting episode. AAP provides detailed guidance on rehydration for vomiting and diarrhea at www.healthychildren.org/English/health-issues/conditions/abdominal/Pages/Treating-Dehydration-with-Electrolyte-Solution.aspx.

DIET MODIFICATION

Breastfed infants should continue nursing on demand. Formula-fed infants should continue their usual formula during rehydration and should receive a volume sufficient to satisfy energy and nutrient requirements. Lactose-free or lactose-reduced formulas usually are unnecessary. Diluting formula can slow resolution of diarrhea and is not recommended.

Older infants and children receiving semisolid or solid foods should continue to receive their usual diet during the illness. Recommended foods include cereals, fruits and vegetables, starches, and pasteurized yogurt. Travelers should avoid giving children food high in simple sugars (e.g., undiluted apple juice, presweetened cereals, gelatins, soft drinks) because these can exacerbate diarrhea by osmotic effects. In addition, foods

high in fat tend to delay gastric emptying, and thus might not be well tolerated by ill children.

Travelers should not withhold food for ≥24 hours. Early feeding can decrease changes in intestinal permeability caused by infection, reduce illness duration, and improve nutritional outcome. Although highly specific diets (e.g., the BRAT [bananas, rice, applesauce, toast] diet) or juice-based and clear fluid diets commonly are recommended, such severely restrictive diets have no scientific basis and should be avoided.

Malaria

Malaria is among the most serious and life-threatening infections acquired by pediatric international travelers. Pediatric VFR travelers are at particularly high risk for malaria infection if they do not receive prophylaxis. Among people reported with malaria in the United States in 2017, 17% were children <18 years old; 89% had traveled to Africa. Seventy percent of the children who were US residents also were VFR travelers, and 61% did not take malaria chemoprophylaxis.

Children with malaria can rapidly develop high levels of parasitemia and are at increased risk for severe complications of malaria, including seizures, coma, and death. Initial symptoms can mimic many other common causes of pediatric febrile illness, which could delay diagnosis and treatment. Among 33 children with imported malaria diagnosed at 11 medical centers in New York City, 11 (32%) had severe malaria and 14 (43%) were initially misdiagnosed. Counsel adults traveling with children to malaria-endemic areas to use preventive measures, be aware of the signs and symptoms of malaria, and seek prompt medical attention if symptoms develop.

ANTIMALARIAL DRUGS

Pediatric doses for malaria prophylaxis are provided in Table 5-27. Calculate dosing based on body weight. Medications used for infants and young children are the same as those recommended for adults, except atovaquone-proguanil, which should not be used for prophylaxis in children weighing <5 kg because of lack of data on safety and efficacy. Doxycycline should not be recommended for malaria prophylaxis for children aged <8 years. Although doxycycline has not been associated with dental staining when given as a routine treatment for some infections, other tetracyclines might cause teeth staining.

Atovaquone-proguanil, chloroquine, and mefloquine have a bitter taste. Mixing pulverized tablets in a small amount of food or drink can facilitate the administration of antimalarial drugs to infants and children. Clinicians also can ask compounding pharmacists to pulverize tablets and prepare gelatin capsules with calculated pediatric doses. A compounding pharmacy can alter the flavoring of malaria medication tablets so that children are more willing to take them. The Find a Compounder section on the Alliance for Pharmacy Compounding website (http://a4pc.org/; 281-933-8400) can help with finding a compounding pharmacy. Because overdose of antimalarial drugs, particularly chloroquine, can be fatal, store medication in childproof containers and keep out of the reach of infants and children.

PERSONAL PROTECTIVE MEASURES & REPELLENT USE

Children should sleep in rooms with air conditioning or screened windows, or sleep under mosquito nets when air conditioning or screens are not available. Mosquito netting should be used over infant carriers. Children can reduce skin exposed to mosquitoes by wearing long pants and long sleeves while outdoors. Clothing and mosquito nets can be treated with an insect repellent/insecticide (e.g., permethrin) that repels and kills ticks, mosquitoes, and other arthropods. Permethrin remains effective through multiple washings. Clothing and mosquito nets should be retreated according to the product label. Permethrin should not be applied to the skin.

Although permethrin provides a longer duration of protection, recommended repellents that can be applied to skin also can be used on clothing and mosquito nets (see Sec. 4, Ch. 6, Mosquitoes, Ticks & Other Arthropods, for more details about these protective measures). The Centers for Disease Control and Prevention (CDC) recommends using US Environmental Protection Agency (EPA)–registered repellents (see www.epa.gov/insect-repellents/find-repellent-right-you) containing one of the following active ingredients: DEET (*N,N*-diethyl-*m*-toluamide); picaridin; oil of

lemon eucalyptus (OLE); PMD (para-menthane-3,8-diol); IR3535; or 2-undecanone (methyl nonyl ketone). Repellent products must state any age restriction; if no age restriction is provided, EPA has not required a restriction on the use of the product. Most EPA-registered repellents can be used on children aged >2 months, except products containing OLE or PMD that specify they should not be used on children aged <3 years. Insect repellents containing DEET, picaridin, IR3535, or 2-undecanone can be used on children without age restriction.

Many repellents contain DEET as the active ingredient. DEET concentration varies considerably between products. The duration of protection varies with DEET concentration; higher concentrations protect longer; products with DEET concentration >50% do not, however, offer a marked increase in protection time.

The EPA has approved DEET for use on children without an age restriction. If used appropriately, DEET does not represent a health problem. The AAP states that the use of products with the lowest effective DEET concentrations (i.e., 20%–30%) seems most prudent for infants and young children, on whom it should be applied sparingly. For more tips on protecting babies and children from mosquito bites, see Box 7-04 and www.cdc.gov/mosquitoes/mosquito-bites/prevent-mosquito-bites.html.

Combination products containing repellents and sunscreen are generally not recommended because instructions for use are different, and sunscreen might need to be reapplied more often and in larger amounts than repellent. In general, apply sunscreen first, and then apply repellent. Mosquito coils should be used with caution in the presence of children to avoid burns and inadvertent ingestion. For detailed information about repellent use and other protective measures, see Sec. 4, Ch. 6, Mosquitoes, Ticks & Other Arthropods.

Rabies

Depending on travel destination and activities, animal exposures and bites might be a health risk for pediatric travelers. Worldwide, rabies is more common in children than adults. In addition to the potential for increased contact with animals, children also are more likely to be bitten on the head or neck, leading to more severe injuries. Counsel children and their families to avoid all stray or unfamiliar animals and to inform adults of any animal contact or bites. Bats throughout the world have the potential to transmit rabies virus.

Travelers should clean all bite and scratch wounds as soon as possible after the event occurs by using soap and water, or povidine iodine if available, for ≥20 minutes to prevent infections, (e.g., rabies). Wounds contaminated with necrotic tissue, dirt, or other foreign materials should be cleaned and debrided promptly by health care professionals, where possible. A course of antibiotics might be appropriate after animal bites or scratches, because these can lead to local or systemic infections. For mammal bites and scratches, children should be evaluated promptly to assess their need for rabies postexposure prophylaxis (see Sec. 4, Ch. 7, Zoonotic Exposures: Bites, Stings, Scratches & Other Hazards; and Sec. 5, Part 2, Ch. 18, Rabies).

BOX 7-04 Protecting infants & children from mosquito bites: recommendations for travelers

Dress children in clothing that covers arms and legs.

Cover strollers and baby carriers with mosquito netting.

Properly use insect repellent

- Always follow all label instructions.
- In general, do not use products containing oil of lemon eucalyptus (OLE) or para-menthane-diol (PMD) on children <3 years old.
- Do not apply insect repellent to a child's hands, eyes, mouth, cuts, or irritated skin.
- Adults should spray insect repellent onto their hands and then apply to a child's face.

Because rabies vaccine and rabies immune globulin might not be available in certain destinations, encourage families traveling to areas with high risk for rabies exposure to seriously consider preexposure rabies vaccination and to purchase medical evacuation insurance, depending on their destination and planned travel activities (see Sec. 7, Ch. 4, Vaccine Recommendations for Infants & Children, and Sec. 6, Ch. 1, Travel Insurance, Travel Health Insurance & Medical Evacuation Insurance).

Soil & Water Contact: Infections & Infestations

Children are more likely than adults to have contact with soil or sand, and therefore could be exposed to diseases caused by infectious stages of parasites in soil, including ascariasis, hookworm, cutaneous or visceral larva migrans, strongyloidiasis, and trichuriasis. Children and infants should wear protective footwear and play on a sheet or towel rather than directly on the ground. Clothing should not be dried on the ground. In countries with a tropical climate, clothing or diapers dried in the open air should be ironed before use to prevent infestation with fly larvae.

Schistosomiasis is a risk to children and adults in endemic areas. While in schistosomiasis-endemic areas (see Sec. 5, Part 3, Ch. 20, Schistosomiasis), children should not bathe, swim, or wade in fresh, unchlorinated water (e.g., lakes, ponds).

NONINFECTIOUS HAZARDS & RISKS

Air Travel

Although air travel is safe for most newborns, infants, and children, people traveling with children should consider a few issues before departure. Children with chronic heart or lung problems might be at risk for hypoxia during flight, and caregivers should consult a clinician before travel.

EAR PAIN

Ear pain can be troublesome for infants and children during descent. Pressure in the middle ear can be equalized by swallowing or chewing; thus, infants should nurse or suck on a bottle, and older children can try chewing gum. Antihistamines and decongestants have not been shown to be of benefit. No evidence suggests that air travel exacerbates the symptoms or complications associated with otitis media.

JET LAG

Travel to different time zones, jet lag, and schedule disruptions can disturb sleep patterns in infants and children, just as in adults (Sec. 8, Ch. 4, Jet Lag).

SAFETY RESTRAINTS

Travelers also should ensure that children can be restrained safely during a flight. Severe turbulence or a crash can create enough momentum that an adult cannot hold onto a child. The safest place for a child on an airplane is in a government-approved child safety restraint system (CRS) or device. The Federal Aviation Administration (FAA) strongly urges travelers to secure children in a CRS for the duration of the flight. Car seats cannot be used in all seats or on all planes, and some airlines might have limited safety equipment available. Travelers should check with the airline about specific restrictions and approved child restraint options. FAA provides additional information at www.faa.gov/travelers/fly_children.

Altitude Illness & Acute Mountain Sickness

Children are as susceptible to the deleterious effects of high elevation travel as adults (see Sec. 4, Ch. 5, High Elevation Travel & Altitude Illness). Slow ascent is the preferable approach for avoiding acute mountain sickness (AMS). Young children unable to talk can show nonspecific symptoms (e.g., loss of appetite or irritability, unexplained fussiness, changes in sleep and activity patterns). Older children might complain of headache or shortness of breath. If children demonstrate unexplained symptoms after an ascent, descent could be necessary.

Acetazolamide is not approved for pediatric use in children aged <12 years for altitude illness but is generally safe for use in children for other indications. Some providers prescribe acetazolamide to prevent AMS in pediatric travelers <12 years of age when a slow ascent is not feasible. The dose is 2.5 mg/kg every 12 hours, up to

a maximum of 125 mg per dose, twice a day. No liquid formulation is available, but tablets can be crushed or packaged by a compounding pharmacy for a correct dose.

Drinking Water Contaminants

Drinking water disinfection does not remove environmental contaminants (e.g., lead or other metals). Travelers might want to carry specific filters designed to remove environmental contaminants, particularly for travel where the risk for exposure is greater due to larger amounts of water consumed (e.g., long-term travel or when living abroad). Filters should meet National Science Foundation (NSF) and American National Standards Institute (ANSI) standards 53 or 58 (see www.cdc.gov/nceh/lead/prevention/sources/water.htm).

Injuries

ACCOMMODATIONS: HOTELS & OTHER LODGINGS

Conditions at hotels and other lodgings abroad might not be as safe as those in the United States; adults traveling with children should carefully inspect accommodations for paint chips, pest poisons, inadequate balcony or stairway railings, or exposed wiring.

Adult caregivers should plan to provide a safe sleeping environment for infants during international travel. Caregivers should follow general recommendations from the AAP task force on preventing sudden infant death syndrome (SIDS) and other sleep-related causes of infant death (see https://services.aap.org/en/patient-care/safe-sleep). Cribs in some locations might not meet US safety standards. Additional information about crib safety is available from the US Consumer Product Safety Commission at www.cpsc.gov/SafeSleep.

MOTOR VEHICLES

Vehicle-related injuries are the leading cause of death in children who travel. Whenever traveling in an automobile or other vehicle, children should be properly restrained in a car seat, booster seat, or with a seat belt, as appropriate for their age, height, and weight. Information about child passenger safety is available at www.healthychildren.org/English/safety-prevention/on-the-go/Pages/Car-Safety-Seats-Information-for-Families.aspx. Car seats often must be brought from home because well-maintained and approved seats might not be available (or limited in availability) in other countries.

In general, children ≤12 years of age are safest when properly buckled in the rear seat of the car while traveling; no one should ever travel in the bed of a pickup truck. Advise families that cars might lack front or rear seatbelts in many low- and middle-income countries. Traveling families should attempt to arrange transportation or rent vehicles with seatbelts and other safety features.

All family members should wear helmets when riding bicycles, motorcycles, or scooters. Pedestrians should take caution when crossing streets, particularly in countries where cars drive on the left, because children might not be used to looking in that direction before crossing.

WATER-RELATED INJURIES & DROWNING

Drowning is the second leading cause of death in young travelers. Children might not be familiar with hazards in the ocean or in rivers. Swimming pools might not have protective fencing to keep toddlers and young children from accessing pool areas unattended. Adults should closely supervise children around water. An adult with swimming skills should be within an arm's length when infants and toddlers are in or around pools and other bodies of water; even for older children and better swimmers, the supervising adult should focus on the child and not be engaged with any distracting activities.

Water safety devices (e.g., personal flotation devices [lifejackets]) might not be available abroad, and families should consider bringing these from home. In addition, adults should ensure children wear protective footwear to avoid injury in many marine environments.

Sun Exposure

Sun exposure, and particularly sunburn before age 15 years, is strongly associated with melanoma and other forms of skin cancer (see Sec. 4, Ch. 1, Sun Exposure). Exposure to ultraviolet (UV) light is greatest near the equator, at high elevations, during midday (10 a.m.–4 p.m.), and where light is reflected off water or snow.

Physical, also known as inorganic, UV filters (sunscreens) generally are recommended for children aged >6 months. Less irritating to children's sensitive skin than chemical sunscreens, physical UV filters (e.g., titanium oxide, zinc oxide) should be applied as directed and reapplied as needed after sweating and water exposure. Babies aged <6 months require extra protection from the sun because of their thinner and more sensitive skin; severe sunburn in young infants is considered a medical emergency.

Advise parents that babies should be kept in the shade and dressed in clothing that covers the entire body. A minimal amount of sunscreen can be applied to small, exposed areas, including the infant's face and hands. For older children, sun-blocking shirts made for swimming preclude having to apply sunscreen over the entire trunk. Hats and sunglasses also reduce sun injury to skin and eyes.

If both sunscreen and a DEET-containing insect repellent are used, apply the sunscreen first and the insect repellent second (i.e., over the sunscreen). Because insect repellent can diminish the level of UV protection provided by the sunscreen by as much as one-third, children should also wear sun-protective clothing, reapply sunscreen, or decrease their time in the sun, accordingly.

OTHER CONSIDERATIONS

Identification

In case family members become separated, each infant or child should carry identifying information and contact numbers in their clothing or pockets. Because of concerns about illegal transport of children across international borders, parents traveling alone with children should carry relevant custody papers or a notarized permission letter from the other parent.

Insurance

As with adult travelers, verify insurance coverage for illnesses and injuries while abroad before departure. Travelers should consider purchasing special medical evacuation insurance for an airlift or air ambulance transport to facilities capable of providing adequate medical care (see Sec. 6, Ch. 1, Travel Insurance, Travel Health Insurance & Medical Evacuation Insurance).

Travel Stress

Changes in schedule, activities, and environment can be stressful for children. Travelers can help decrease these stresses by including children in planning for the trip and bringing along familiar toys or other objects. For children with chronic illnesses, make decisions regarding timing and itinerary in consultation with the child's health care providers.

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VACCINE RECOMMENDATIONS FOR INFANTS & CHILDREN

Michelle Weinberg

Vaccinating children for travel requires careful evaluation. Whenever possible, children should complete routine childhood immunizations on a normal schedule. Travel at an earlier age, however, might require accelerated vaccine schedules. Not all travel-related vaccines are effective in infants, and some are specifically contraindicated.

Recommended childhood and adolescent immunization schedules are available at www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html. The Centers for Disease Control and Prevention (CDC) provides a catch-up schedule for children and adolescents who start a vaccination schedule late or who are >1 month behind (see www.cdc.gov/vaccines/schedules/hcp/imz/catchup.html). Tables also describe the recommended minimum intervals between doses for children who need to be vaccinated on an accelerated schedule, which could be necessary before international travel.

Country-specific vaccination recommendations and requirements for departure and entry vary over time. For example, proof of yellow fever vaccination is required for entry into certain countries. Meningococcal vaccination is required for travelers entering Saudi Arabia for Umrah or the annual Hajj pilgrimage. The World Health Organization (WHO) has issued temporary vaccination recommendations for residents of and long-term visitors to countries with active circulation of wild or vaccine-derived poliovirus. Some countries might require coronavirus disease 2019 (COVID-19) vaccine, testing, or both for entry. Check the CDC Travelers' Health website for current requirements and recommendations (https://wwwnc.cdc.gov/travel).

Additional information about diseases and routine vaccination is available in the disease-specific chapters in Section 5. Tools for determining routine and catch-up childhood vaccination are available at www.cdc.gov/vaccines/schedules/index.html.

MODIFYING IMMUNIZATION SCHEDULES FOR INFANTS & YOUNG CHILDREN BEFORE INTERNATIONAL TRAVEL

Several factors influence recommendations for the age at which a vaccine is administered, including age-specific risks for the disease and its complications, age-dependent ability to develop an adequate immune response to a vaccine, and potential interference with the immune response by passively transferred maternal antibodies.

Immunization schedules for infants and children in the United States do not provide guidance on modifications for people traveling internationally before the age when specific vaccines are routinely recommended. Age limits for vaccine administration are based on the risk for potential adverse events (e.g., yellow fever vaccine), lack of efficacy data or inadequate immune response (e.g., influenza vaccine, polysaccharide vaccines), maternal antibody interference and immaturity of the immune system (e.g., measles-mumps-rubella [MMR] vaccine), or lack of safety data.

To help parents decide when to travel with an infant or young child, advise them that the earliest opportunity to receive routinely recommended immunizations in the United States (except for doses of hepatitis B vaccine at birth and age 1 month) is when the baby is 6 weeks old. In general, live-virus vaccines (MMR, varicella, yellow fever) should be administered on the same day or spaced ≥28 days apart.

ROUTINE INFANT & CHILDHOOD VACCINES

Children should be vaccinated against diphtheria, *Haemophilus influenzae* type b (Hib), hepatitis A and hepatitis B virus, human papillomavirus,

influenza, measles, mumps, *Neisseria meningitidis*, pertussis, polio, rotavirus, rubella, *Streptococcus pneumoniae*, tetanus, and varicella. To complete a vaccine series before travel, doses can be administered at the minimum ages and dose intervals. Inform parents that infants and children who have not received all recommended vaccine doses might not be fully protected. Rotavirus vaccine is unique among the routine vaccines given to infants in the United States because it has maximum ages for both the first and last doses; specifically consider the timing of travel so that the infant will be able to receive the complete vaccine series, if possible.

Coronavirus Disease 2019

The COVID-19 pandemic continues to evolve, and CDC's vaccination recommendations are updated regularly. For the most current recommendations for children and teens, see www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html. COVID-19 vaccines available for use in the United States can be administered simultaneously with all other vaccines.

Hepatitis A

Hepatitis A infection is usually mild or asymptomatic in infants and children <5 years old. Infected children can, however, transmit the infection to older children and adults, age groups at greater risk for severe disease. Ensure vaccination for all children traveling to areas with an intermediate or high risk for hepatitis A (see Sec. 5, Part 2, Ch. 7, Hepatitis A). Routine hepatitis A vaccination for children aged ≥12 months consists of 2 doses, separated by ≥6 months. Ideally, the first dose should be administered ≥2 weeks before travel. When protection against hepatitis A is recommended, infants aged 6–11 months should receive 1 dose of hepatitis A vaccine before travel outside the United States.

Hepatitis A vaccine is considered safe and immunogenic in infants; doses administered before 12 months of age, however, can result in a suboptimal immune response, particularly in infants with passively acquired maternal antibody. Therefore, doses administered to infants <12 months old are not considered to provide long-term protection; initiate the 2-dose hepatitis A vaccine series at age 12 months according to the routine immunization schedule.

HEPATITIS A IMMUNE GLOBULIN

When protection against hepatitis A is recommended, infants <6 months old should receive immune globulin (IG) before travel. One dose of 0.1 mL/kg intramuscularly provides protection for ≤1 month. Infants who do not receive vaccination who will be traveling for >1 month but ≤2 months should receive an IG dose of 0.2 mL/kg. If the traveler remains in a high-risk setting, IG (0.2 mL/kg) should be administered every 2 months until hepatitis A vaccine can be given at ≥6 months of age, if not contraindicated.

For optimal protection, children aged ≥1 year who are immunocompromised or who have chronic medical conditions, and who will be traveling to a high-risk area in <2 weeks, should receive the initial dose of hepatitis A vaccine and IG at separate anatomic injection sites.

RECOMMENDED DOSING INTERVALS FOR COADMINISTRATION OF LIVE-VIRUS VACCINES

Hepatitis A IG is an antibody-containing product that does not interfere with the immune response to yellow fever vaccine but can inhibit the response to other injected live-virus vaccines (e.g., MMR, varicella) for up to 6 months after administration (see Sec. 2, Ch. 3, Vaccination & Immunoprophylaxis—General Principles).

MMR vaccine is recommended for all infants aged 6–11 months traveling internationally. Because measles in infancy is a more severe disease than hepatitis A, administer hepatitis A vaccine and MMR vaccine simultaneously to infants aged 6–11 months to provide protection against hepatitis A and measles, but do not give hepatitis A IG.

If the interval between MMR or varicella vaccine administration and subsequent administration of an antibody-containing product is <14 days, repeat vaccination after the recommended interval unless serologic testing indicates a protective antibody response. For information about dosing intervals, see The Timing and Spacing of Immunobiologics, General Best Practice Guidelines for Immunization: Best Practices Guidance of the Advisory Committee

on Immunization Practices, Table 3-4 (www.cdc.gov/vaccines/hcp/acip-recs/general-recs/timing.html#t-04) and Table 3-5 (www.cdc.gov/vaccines/hcp/acip-recs/general-recs/timing.html#t-05).

Hepatitis B

For certain age groups, hepatitis B vaccine can be administered with an accelerated schedule of 4 doses of vaccine given at 0, 1, 2, and 12 months; the last dose can be given after the child returns from travel (see Sec. 5, Part 2, Ch. 8, Hepatitis B, for details).

Influenza

Influenza viruses circulate predominantly in the winter months in temperate regions (typically November–April in the Northern Hemisphere and April–September in the Southern Hemisphere) but can occur year-round in tropical climates (see Sec. 5, Part 2, Ch. 12, Influenza). Because influenza viruses can circulate any time of the year, travelers aged ≥6 months who were not vaccinated during the influenza season in their country of residence should be vaccinated ≥2 weeks before departure if vaccine is available.

Children aged 6 months–8 years who have never received influenza vaccine, or who have not previously received a lifetime total of ≥2 doses, should receive 2 doses separated by ≥4 weeks. For annually updated recommendations about seasonal influenza vaccination, see www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/flu.html.

Measles-Mumps-Rubella or Measles-Mumps-Rubella-Varicella

Children traveling abroad need to be vaccinated against measles, mumps, and rubella at an age earlier than what is routinely recommended. Infants 6–11 months old should receive 1 MMR vaccine dose. Infants vaccinated before age 12 months must be revaccinated on or after their first birthday with 2 doses of MMR vaccine (separated by ≥28 days) or measles-mumps-rubella-varicella (MMRV) vaccine (separated ≥3 months). The minimum interval between any varicella-containing vaccine (MMRV or monovalent varicella) is 3 months.

MMRV vaccine is licensed for use in children aged 12 months–12 years and should not be given outside this age group. Recipients of a first dose of MMRV vaccine have a greater risk for febrile seizures compared with recipients of MMR and varicella vaccines administered concomitantly. Unless the caregiver expresses a preference for MMRV, CDC recommends administering separate MMR and varicella vaccine for the first dose of MMR and varicella vaccination for children 12–47 months.

Meningococcal

QUADRIVALENT CONJUGATE

Children aged 2 months–18 years who travel to or reside in areas of sub-Saharan Africa known as the meningitis belt during the dry season (December–June) should receive quadrivalent meningococcal conjugate (MenACWY) vaccine (see Sec. 5, Part 1, Ch. 13, Meningococcal Disease). In addition, travelers are required to have meningococcal vaccination to enter Saudi Arabia when traveling to Mecca for Umrah or the annual Hajj pilgrimage. The CDC Travelers' Health website (https://wwwnc.cdc.gov/travel) provides annual health requirements and recommendations for US travelers going to Mecca for Umrah or Hajj (also see Sec. 10, Part 1, Ch. 2, Saudi Arabia: Hajj & Umrah Pilgrimages).

The schedule for primary series meningococcal vaccine and booster doses varies depending on the vaccine administered (www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html#note-mening).

MENINGOCOCCAL B

Unless an outbreak of serogroup B disease has been reported, vaccination with a serogroup B meningococcal (MenB) vaccine is not routinely recommended for travel to the meningitis belt or other regions of the world. Although MenB vaccine is not licensed in the United States for children <10 years of age, some European countries recently introduced MenB vaccine as a routine immunization for infants. Some countries might have other meningococcal vaccines available. Consider meningococcal vaccination for infants residing in these countries according to the routine infant immunization recommendations of that country.

Polio

Polio vaccine is recommended for travelers going to countries with evidence of wild poliovirus (WPV) or vaccine-derived poliovirus circulating during the last 12 months, and for travelers with a high risk for exposure to someone with imported WPV infection when traveling to some countries that border areas with WPV circulation. Refer to the CDC Travelers' Health website destination pages for current polio vaccine recommendations (https://wwwnc.cdc.gov/travel/destinations/list).

Ensure that travelers complete the recommended age-appropriate polio vaccine series and receive a single lifetime booster dose, if necessary. Infants and children should receive an accelerated schedule to complete the routine series. See Sec. 5, Part 2, Ch. 17, Poliomyelitis, and CDC's Immunization Schedules website (www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html#note-polio) for information about accelerated schedules.

People ≥18 years of age traveling to areas where polio vaccine is recommended and who have received a routine series with either inactivated polio vaccine (IPV) or live oral polio vaccine in childhood should receive a single lifetime booster dose of IPV before departure. Available data do not indicate the need for more than a single lifetime booster dose with IPV. Requirements for long-term travelers might apply, however, when departing from certain countries.

LONG-TERM TRAVELERS TO COUNTRIES WITH POLIOVIRUS TRANSMISSION

In May 2014, the World Health Organization (WHO) declared the international spread of polio to be a Public Health Emergency of International Concern under the authority of the International Health Regulations (2005). To prevent further spread of disease, WHO issued temporary polio vaccine recommendations for long-term travelers (staying >4 weeks) and residents departing from countries with WPV transmission ("exporting WPV" or "infected with WPV") or with circulating vaccine-derived polioviruses types 1 or 3.

Long-term travelers and residents could be required to show proof of polio vaccination when departing from these countries for any destination. All polio vaccination administration should be documented on an International Certificate of Vaccination or Prophylaxis (ICVP). For ordering information and instructions on how to fill out the ICVP, see https://wwwnc.cdc.gov/travel/page/icvp. The polio vaccine must be received 4 weeks–12 months before the date of departure from the polio-infected country.

Country requirements can change, so clinicians should check for updates on the CDC Travelers' Health website (https://wwwnc.cdc.gov/travel/).

TRAVEL VACCINES FOR INFANTS & CHILDREN

Dengue

Dengue can cause mild to severe illness (see Sec. 5, Part 2, Ch. 4, Dengue). Although many people have asymptomatic infections, for some children dengue can be life-threatening. Travelers should adhere to mosquito protection measures during travel to dengue-endemic areas (see Sec. 4, Ch. 6, Mosquitoes, Ticks & Other Arthropods).

In June 2021, the Advisory Committee on Immunization Practices (ACIP) recommended the use of a live attenuated dengue virus vaccine, Dengvaxia (Sanofi Pasteur), to prevent disease in children aged 9–16 years. Children eligible to receive the vaccine include those with laboratory-confirmed previous dengue virus infection who live in areas of the United States, including the US territories of American Samoa, Puerto Rico, and the US Virgin Islands; and freely associated states, the Federated States of Micronesia, the Republic of Marshall Islands, and the Republic of Palau. Dengvaxia is not approved for use in US travelers who are visiting but who do not live in areas where dengue is endemic.

Only people who test positive for previous dengue infection or who have other laboratory-confirmed evidence of a previous dengue infection are eligible for vaccination with Dengvaxia (www.cdc.gov/dengue/vaccine/hcp/testing.html). In people without previous dengue infection, Dengvaxia can increase the risk for severe illness and hospitalization if the person gets infected after vaccination. Serodiagnostic tests recommended by health authorities with acceptable performance (≥75% sensitivity, ≥98% specificity) are available to test for evidence of previous dengue infection.

The vaccine is a series of 3 doses, administered 6 months apart at month 0, 6, and 12 months.

Japanese Encephalitis

Japanese encephalitis (JE) virus is transmitted by mosquitoes and is endemic throughout most of Asia and parts of the western Pacific. JE risk can be seasonal in temperate climates and year-round in more tropical climates. Risk to short-term travelers and those who confine their travel to urban centers is considered low. JE vaccine is recommended for travelers who plan to spend ≥1 month in endemic areas during JE virus transmission season. Consider JE vaccine for short-term (<1 month) travelers whose itinerary or activities could increase their risk for JE virus exposure. The decision to vaccinate a child should follow the more detailed recommendations found in Sec. 5, Part 2, Ch. 13, Japanese Encephalitis.

An inactivated Vero cell culture–derived JE vaccine (IXIARO) was licensed by the US Food and Drug Administration (FDA) in 2009 for use in the United States for travelers aged ≥17 years. In 2013, the recommendations were expanded, and the vaccine was licensed for use in children ≥2 months of age. For children aged 2 months–17 years, the primary series consists of 2 intramuscular doses administered 28 days apart. For travelers who received their primary JE vaccine series ≥1 year prior to potential JE virus exposure, ACIP recommends providing a booster dose before departure. Information on age-appropriate dosing is available at www.cdc.gov/japaneseencephalitis/vaccine/vaccineChildren.html.

Rabies

Rabies virus causes an acute viral encephalitis that is virtually 100% fatal. Traveling children can be at increased risk for rabies exposure, mainly from dogs that roam the streets in low- and middle-income countries. Bat bites carry a potential risk for rabies throughout the world. In addition to taking measures to avoid animal bites and scratches (see Sec. 4, Ch. 7, Zoonotic Exposures: Bites, Stings, Scratches & Other Hazards), preexposure and postexposure rabies prophylaxis is part of a broader approach to preventing this disease. Follow the recommendations in Sec. 5, Part 2, Ch. 18, Rabies, when making decisions about whether to provide rabies preexposure prophylaxis for children.

PREEXPOSURE PROPHYLAXIS

In June 2021, to align with the recently revised adult schedule, ACIP adjusted the number of recommended doses of rabies preexposure prophylaxis in children downward, from 3 to 2. For immunocompetent children <18 years old, administer the first dose of vaccine on day 0 and a second dose 7 days later (see Sec. 5, Part 2, Ch. 19, . . . *perspectives*: Rabies Immunization).

The advantages of the revised schedule are that it is both less expensive and easier to complete prior to travel. There are, however, no data on the duration of protection afforded by this 2-dose series. Because of this uncertainty, travelers with a sustained risk for rabies exposure should either have a titer drawn or receive a third dose of vaccine within 3 years of the initial series. Travelers unlikely to visit an at-risk destination after 3 years require no further titers or boosters unless they have a subsequent exposure.

POSTEXPOSURE PROPHYLAXIS

Children who have not received preexposure immunization and who might have been exposed to rabies require a weight-based dose of human rabies immune globulin (RIG) and a series of 4 rabies vaccine doses on days 0, 3, 7, and 14. Decisions about any changes in how to manage postexposure prophylaxis, schedule deviations for pre- or postexposure prophylaxis, and postexposure prophylaxis initiated abroad are expected from the ACIP.

Tick-Borne Encephalitis

Tick-borne encephalitis (TBE) is a viral disease transmitted by *Ixodes* ticks in parts of Asia and Europe. Rare in US travelers, TBE is usually asymptomatic but can appear as a biphasic illness with central nervous system involvement (see Sec. 5, Part 2, Ch. 23, Tick-Borne Encephalitis). Although TBE infection tends to be less severe in children, residual symptoms and neurologic deficits have been described.

Most infections result from the bite of infected tick, typically acquired when a person is bicycling, camping, hiking, or participating in other outdoor

activities in brushy or forested areas. TBE also can be acquired by ingesting unpasteurized dairy products from infected animals, or, rarely, from direct person-to-person spread via blood transfusion, solid organ transplantation, or breastfeeding.

In August 2021, the FDA approved a TBE vaccine for people aged ≥1 year (www.fda.gov/vaccines-blood-biologics/ticovac); in February 2022, ACIP approved recommendations for vaccine use among people traveling or moving to a TBE-endemic area who will have extensive tick exposure based on planned outdoor activities and itinerary. Primary vaccination consists of 3 doses; the schedule varies by age. For children 1–15 years old, give the second dose 1–3 months after the first dose; for children aged ≥16 years, give the second dose 14 days–3 months after the first dose. All children should receive the third dose 5–12 months after receiving their second dose of the vaccine. A booster (fourth) dose can be given ≥3 years after completion of the primary immunization series if ongoing exposure or reexposure is expected.

Typhoid

Typhoid fever is caused by the bacterium *Salmonella enterica* serotype Typhi (see Sec. 5, Part 1, Ch. 24, Typhoid & Paratyphoid Fever). Travelers can avoid typhoid fever by following safe food and water precautions and frequently washing hands. Typhoid vaccine is recommended for travelers going to areas with a recognized risk for *Salmonella* Typhi exposure.

Two typhoid vaccines are licensed for use in the United States: Vi capsular polysaccharide vaccine (ViCPS) administered intramuscularly, and oral live attenuated vaccine (Ty21a). Both vaccines induce a protective response in 50%–80% of recipients. The ViCPS vaccine can be administered to children aged ≥2 years, who should receive a booster dose 2 years later if continued protection is needed. The Ty21a vaccine consists of a series of 4 capsules (1 taken orally every other day), which can be administered to children aged ≥6 years. Do not open capsules for administration; capsules must be swallowed whole. All 4 doses should be taken ≥1 week before potential exposure. A booster series for Ty21a should be taken every 5 years, if indicated.

Yellow Fever

Yellow fever, a disease transmitted by mosquitoes, is endemic to certain areas of Africa and South America (see Sec. 5, Part 2, Ch. 26, Yellow Fever). Proof of vaccination against yellow fever is required for entry into some countries (see Sec. 2, Ch. 5, Yellow Fever Vaccine & Malaria Prevention Information, by Country). Infants and children ≥9 months old and without contraindications should be vaccinated before traveling to countries where yellow fever is endemic.

Infants aged <9 months are at greater risk for developing encephalitis from yellow fever vaccine, which is a live-virus vaccine. Studies conducted during the early 1950s identified 4 cases of encephalitis out of 1,000 children aged <6 months who received yellow fever vaccine. An additional 10 cases of encephalitis associated with yellow fever vaccine administered to infants aged <4 months were reported worldwide during the 1950s.

Advise travelers with infants aged <9 months against traveling to areas where yellow fever is endemic. ACIP advises against administering yellow fever vaccine to infants aged <6 months. Infants aged 6–8 months should be vaccinated only if they must travel to areas of ongoing epidemic yellow fever, and if a high level of protection against mosquito bites is not possible. Clinicians considering vaccinating infants aged 6–8 months can consult their respective state health departments or CDC toll-free at 800-CDC-INFO (800-232-4636) or https://wwwn.cdc.gov/dcs/ContactUs/Form.

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INTERNATIONAL ADOPTION

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Since 1999, >275,000 children have come to the United States to join families through international adoption. Children being adopted from other countries can have infectious (and environmental) diseases due to exposure to pathogens endemic to their birth country; they also might be underimmunized or unimmunized, have lacked access to clean water, lived in crowded or possibly unsanitary conditions, and be malnourished. Families traveling to unite with their adopted child, siblings who wait at home for the child's arrival, extended family members, and childcare providers are all at risk of acquiring infectious diseases secondary to travel or from contact with their new family member. Clinicians can play an important role in helping families prepare to travel and welcome adoptees safely.

PREPARING ADOPTIVE PARENTS & FAMILIES

Prospective adoptive parents should schedule a pretravel visit with a travel health clinic. To best prepare adoptive parents and families going to meet their new child, travel health providers should be aware of disease risks in the adopted child's country of origin, the medical and social history of the adoptee (if available), the medical and vaccination histories of family members traveling to meet the child, the season of travel, the length of stay in the country, and the itinerary. Provide prospective adoptive parents and any family members traveling with them with needed vaccinations, malaria prophylaxis, diarrhea prevention and treatment, advice on coronavirus disease 2019 (COVID-19) prevention measures and travel requirements, general advice on travel and food safety, and other travel-related health issues, as outlined elsewhere in the Centers for Disease Control and Prevention (CDC) Yellow Book.

Vaccinations

All family members should be up to date with all routine immunizations; this includes those who travel to meet the adopted child, those who remain at home, and all extended family members. Provided minimum age and dose intervals are followed, an accelerated dose schedule can be used to complete a vaccine series, if necessary.

Ensure all age-eligible people who will be in the household or in close contact with the adopted

child (e.g., caregivers) are protected against diphtheria, hepatitis A virus (HAV), measles, pertussis, polio, tetanus, and varicella; include hepatitis B virus (HBV) vaccine if the adoptee has known infection or if the family is traveling to a country with high or intermediate levels of endemic HBV infection (see Sec. 5, Part 2, Ch. 8, Hepatitis B). Make sure all eligible family members are up to date with their COVID-19 vaccines (www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html).

HEPATITIS

Before the adopted child's arrival, immunize unprotected family members and close contacts against HAV. Because hepatitis B vaccine has only been routinely given since 1991, some adult family members and caretakers might need to be immunized if the adoptee has a known HBV infection.

MEASLES

Measles immunity or 2 doses of measles-mumps-rubella (MMR) vaccine separated by ≥28 days should be documented for all people born in or after 1957.

POLIO

If the adopted child is from a polio-endemic area (www.polioeradication.org, https://wwwnc.cdc.gov/travel/notices), ensure family members and caretakers have completed the recommended age-appropriate polio vaccine series. A one-time inactivated polio vaccine (IPV) booster for adults who completed the primary series in the past is recommended if they are traveling to polio-endemic areas; vaccination also can be considered for adults who remain at home but who will be in close contact caring for the child. Additional polio vaccine requirements for residents and long-term travelers (staying >4 weeks) departing from countries with polio transmission could affect outbound travel plans (see Sec. 5, Part 2, Ch. 17, Poliomyelitis).

TETANUS-DIPHTHERIA-PERTUSSIS

Adults who have not received the tetanus-diphtheria-acellular pertussis (Tdap) vaccine, including adults >65 years old, should receive a single dose to protect against diphtheria, pertussis, and tetanus.

VARICELLA

Administer varicella vaccine to people born in or after 1980 without a history of varicella disease, documented immunity (serology), or documentation of 2 doses of varicella vaccine.

OVERSEAS MEDICAL EXAMINATION

All immigrants, including children adopted internationally by US citizens, must undergo a medical examination in their country of origin, performed by a physician designated by the US Department of State. Additional information about the medical examination for internationally adopted children is available at https://travel.state.gov/content/travel/en/Intercountry-Adoption/Adoption-Process/how-to-adopt/medical-examination.html and https://eforms.state.gov/Forms/ds1981.pdf.

The explicit purpose of the overseas medical examination is to identify applicants with inadmissible health-related conditions. Prospective adoptive parents should not rely on this evaluation to detect all disabilities and illnesses a child might have. To understand more about possible health concerns for an individual child, prospective adoptive parents should consider a preadoption medical review with a pediatrician familiar with the health issues of internationally adopted children. That provider can review the available medical history and vaccination records for the child, thereby preparing parents for any potential health issues that might exist.

Prospective adoptive parents can then proactively schedule any recommended follow-up, including an initial medical examination that is recommended within 2 weeks of arrival to the United States (see www.cdc.gov/immigrantrefugeehealth/adoption/finding-doctor.html). Adoptive parents might receive a copy of the overseas examination, recorded on US Department of State medical forms, to give to clinicians at the initial follow-up medical examination.

FOLLOW-UP MEDICAL EXAMINATION

Providing health care to internationally adopted children can be challenging for several reasons (see Box 7-05). Adopted children should have a

BOX 7-05 Challenges to providing care to internationally adopted children

- Absence of a complete medical history
- Increased risk for developmental delays and psychological issues
- Lack of a biological family history
- Previously unidentified medical problems
- Questionable reliability of immunization records
- Variations in preadoption living standards
- Varying disease epidemiology in countries of origin

complete medical examination ≤2 weeks after their US arrival—earlier than that if they have anorexia, diarrhea, fever, vomiting, or other apparent health issues. In addition, a developmental screening examination conducted by an experienced clinician can help identify if immediate referrals should be made for a more detailed neurodevelopmental assessment and therapies. Clinicians might recommend further evaluation based on the age of the child, their country of origin, developmental status, nutritional status, previous living conditions, and the adoptive family's specific questions. Concerns raised during the preadoption medical review could dictate further investigation.

Infectious Diseases Screening

Screening recommendations for infectious diseases vary by organization. See Table 7-01 for the current panel of infectious disease screening tests recommended by the American Academy of Pediatrics (AAP) for internationally adopted children.

EOSINOPHILIA

All internationally adopted children should have a complete blood count with differential. An eosinophil count >450 cells/mL warrants further evaluation; intestinal parasite screening can identify some helminth infections. Investigation of eosinophilia also should include serologic evaluation for *Strongyloides stercoralis* and *Toxocara canis*; both are found worldwide. Perform serologic testing for filariasis and *Schistosoma* spp. in children arriving from endemic countries.

HEPATITIS A

Screening asymptomatic people for hepatitis A is generally not recommended; clinicians might, however, decide to test internationally adopted children for HAV IgG and IgM to identify those who are acutely infected and shedding virus. Vaccinate adopted children against HAV if they are not already immune.

In 2007 and early 2008, multiple cases of hepatitis A were reported in the United States secondary to exposure to newly arrived internationally adopted children. Some of these cases involved extended family members not living in the household. Identification of acutely infected toddlers new to the United States could prevent further transmission. If an acute infection is found in a child, close contacts can receive hepatitis A vaccine or immunoglobulin to prevent infection. In addition, serologic testing is a cost-effective way to identify children with past infection.

HEPATITIS B

With the widespread use of the hepatitis B vaccine, the prevalence of HBV infection has decreased overall, and lower rates of infection (1%–5%) have been reported in newly arrived international adoptees. In recent years, most children with HBV infection were known to be infected prior to adoption.

All internationally adopted children should be screened for HBV infection with serologic tests for hepatitis B surface antigen (HBsAg), hepatitis B surface antibody, and hepatitis B core antibody to determine past infection, current infection, or protection due to prior vaccination. For children positive for HBsAg, retest 6 months later to determine if they have chronic infection. Report results of a positive HBsAg test to the state health department.

HBV is highly transmissible within households; for this reason, all members of households adopting children with chronic HBV infection should be

Table 7-01 American Academy of Pediatrics (Red Book) recommended infectious disease screening for international adoptees[1,2]

INFECTIONS & DISEASES	RECOMMENDED TESTING	INDICATIONS
Filariasis, lymphatic	Serology	Eosinophilia; from endemic country
Hepatitis A	Serology	As appropriate (see text)
Hepatitis B	Serology	All children
Hepatitis C	Serology	As appropriate (see text)
HIV 1 & 2	Serology (antigen/antibody)	All children
Intestinal pathogens	Stool examination for O&P (1–3 specimens)	All children
	Cryptosporidium antigen testing (1 specimen)	All children
	Giardia duodenalis antigen testing (1 specimen)	All children
Schistosomiasis	Species serology	Eosinophilia or hematuria; from endemic country
Strongyloidiasis	Species serology	Eosinophilia
Syphilis	Serology (treponemal + nontreponemal testing)	All children
Toxocara canis	Serology	Eosinophilia
Trypanosoma cruzi	Serology	From endemic country
Tuberculosis[3]	TST	<2 years of age
	IGRA or TST	≥2 years of age
	IGRA	≥2 years of age previously vaccinated with BCG

Abbreviations: BCG, bacillus Calmette-Guérin; IGRA, interferon-γ release assay; O&P, ova and parasites; TST, tuberculin skin test

[1]Report all reportable diseases to the state or local health department.
[2]Collect a complete blood cell count with differential and red blood cell indices in addition to the disease-specific tests listed in the table.
[3]Repeat testing in 3–6 months if initial testing is negative.

immunized. Children with chronic HBV infection should receive additional tests for hepatitis e antigen (HBeAg), hepatitis B e antibody (anti-HBe), HBV viral load, hepatitis D virus antibody, and liver function, and should have a consultation with a pediatric gastroenterologist for long-term management.

Although not currently recommended by the CDC or the AAP, consider repeat screening 6 months after arrival for all children who initially test negative for hepatitis B surface antibody and surface antigen.

HEPATITIS C

The prevalence of hepatitis C in internationally adopted children is low. Most children with hepatitis C virus (HCV) infection are asymptomatic,

and screening for risk factors (e.g., having an HCV-positive mother, surgery in the child's birth country, a history of transfusions, major dental work, intravenous drug use, tattoos, sexual activity or abuse, female genital cutting, traditional cutting) generally is not possible. But because effective treatments are available and infected patients need close follow-up to identify long-term complications, consider routine screening for HCV.

Use antibody testing (IgG ELISA) to screen children ≥18 months of age; use PCR testing for younger children. Refer children with HCV infection to a gastroenterologist for further evaluation, management, and treatment.

HIV

HIV screening is recommended for all internationally adopted children. HIV antibodies found in children aged <18 months could reflect maternal antibodies rather than infection of the infant. An HIV-1/HIV-2 antigen/antibody combination assay is used for standard screening, but some experts recommend PCR for any infant aged <6 months on arrival to the United States. A PCR assay for HIV DNA can confirm the diagnosis in an infant or child. If PCR testing is done, 2 negative results from assays administered 1 month apart, at least 1 of which is done after the age of 4 months, are necessary to exclude infection. Some experts recommend repeating screening for HIV antibodies 6 months after arrival if the initial test results are negative. Refer children with HIV infection to a specialist.

INTESTINAL PATHOGENS

Children treated for intestinal pathogens who have persistent growth delay, or who have ongoing or recurrent symptoms or unexplained anemia, merit a more extensive work-up. Notify public health authorities of reportable infections, and forward isolates for surveillance as appropriate.

PARASITIC

Gastrointestinal parasites commonly are seen in international adoptees, but prevalence varies by age and birth country. As children become older, the risk for parasitic infection and detection increases. The presence or absence of symptoms is not predictive of intestinal parasites; thus, screening is needed. In both past and more recent studies, the highest rates of parasite detection are reported among children adopted from Ukraine and from African, Latin American, and Asian countries, as compared to children coming from Russia and other countries in Eastern Europe. Unlike refugees, internationally adopted children are not treated for parasites before departure, and some clinicians opt to treat newly arrived adoptees with a single dose of albendazole.

Three stool samples collected in the early morning, 2–3 days apart, and placed in a container with preservative provides the highest yield for ova and parasite (O&P) detection. In addition, because routine O&P analysis is unlikely to include testing for either *Cryptosporidium* or *Giardia*, order the combined antigen test for these 2 parasites. *Giardia duodenalis* is the parasite most often identified.

BACTERIAL

Conduct additional stool testing for children with fever and diarrhea, especially acute-onset bloody diarrhea. Non-culture methods (e.g., gastrointestinal pathogen panels with PCR) commonly are used. If a bacterial pathogen is identified by a non-culture method, collect and culture samples to determine antimicrobial susceptibility and inform treatment decisions; bacterial pathogens can be resistant to antibiotics.

MALARIA

Routine malaria screening is not recommended for internationally adopted children. Instead, obtain thick and thin malaria smears immediately for any child coming from a malaria-endemic area who presents with fever or who has symptomatic splenomegaly (i.e., splenic enlargement plus fever or chills). Rapid diagnostic tests (RDTs) for malaria can help expedite the diagnosis, but microscopy is still required to confirm the results and to determine the degree of parasitemia (see Sec. 5, Part 3, Ch. 16, Malaria). PCR testing can confirm the species of parasite after the diagnosis has been established by either smear microscopy or RDT.

Further evaluation also is warranted in asymptomatic children with splenomegaly who come from areas endemic for malaria, as they could be exhibiting hyperreactive malaria splenomegaly.

This evaluation should include antibody titers for malaria, since asymptomatic children with splenomegaly caused by repeated malaria infections can have high titers but negative smears.

SEXUALLY TRANSMITTED INFECTIONS

CHLAMYDIA & GONORRHEA

Although screening for sexually transmitted infections other than HIV and syphilis is not routinely recommended, some experts will screen all children >5 years of age for chlamydia and gonorrhea. Regardless of age, if questions or concerns of sexual abuse are present, or if HIV or syphilis are diagnosed in the child, perform chlamydia and gonorrhea screening.

SYPHILIS

Screening for *Treponema pallidum* is recommended for all internationally adopted children. Initial screening is done with both nontreponemal and treponemal tests. Treponemal tests remain positive for life in most cases, even after successful treatment, and are specific for treponemal diseases, including syphilis and other diseases (e.g., bejel, pinta, yaws) found in some countries.

In children with a history of syphilis, documentation is rarely available for the initial evaluation (serology and lumbar puncture results with cell count, protein, VDRL), treatment (antibiotic used, dose, frequency, and duration), and follow-up serologic testing; therefore, conduct a full evaluation for disease, and provide treponemal treatment depending on the results.

TRYPANOSOMIASIS / CHAGAS DISEASE

Chagas disease is endemic to much of Mexico and throughout countries in Central and South America (see Sec. 5, Part 3, Ch. 25, American Trypanosomiasis / Chagas Disease). Infection risk varies by region within endemic countries. Although the risk for *Trypanosoma cruzi* infection is likely low in children adopted from endemic areas, consider screening.

Serologic testing when the child is aged 9–12 months will avoid possible false-positive results from maternal antibodies. PCR testing can be done for children <9 months of age. Refer children who test positive for Chagas disease to a specialist for further evaluation and management; treatment is effective.

TUBERCULOSIS

Internationally adopted children have 4–6 times the risk for tuberculosis (TB) compared to their US-born peers. TB screening is an integral part of the pretravel overseas medical examination; check with adoptive parents or with the local health department for screening results. If results are not immediately available, screen all internationally adopted children for TB after they arrive in the United States; report any positive cases to the state health department.

Screening for TB after US arrival is important because TB can be more severe in young children and can reactivate when the child gets older. To screen, AAP recommends a tuberculin skin test (TST) for children <2 years of age. For children ≥2 years of age, use either a TST or an interferon-γ release assay (IGRA). For children previously vaccinated with bacillus Calmette-Guérin (BCG), IGRAs appear to be more specific than the TST for *Mycobacterium tuberculosis* infection (see Sec. 5, Part 1, Ch. 23, . . . *perspectives*: Testing Travelers for *Mycobacterium tuberculosis* Infection). On arrival to the United States, some children might be anergic (i.e., have a false negative TB screen) due to malnutrition, stress, or untreated HIV infection, or they might have been infected just prior to travel. Thus, if the initial screen is negative, repeat testing 3–6 months after arrival.

If the TST or IGRA is positive, the child has TB infection, which requires additional evaluation to determine whether the child has TB disease. If a child has evidence of TB disease, consult with an infectious disease expert. Additional information is available at www.cdc.gov/tb/topic/treatment/ltbi.htm.

Vaccinations

The US Immigration and Nationality Act requires everyone seeking an immigrant visa for permanent residency to show proof of having received Advisory Committee on Immunization Practices (ACIP)-recommended vaccines before immigration (see www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html). This requirement extends to all immigrant infants and children

entering the United States. Although internationally adopted children aged <10 years are exempt from the overseas immunization requirements, CDC encourages vaccination prior to travel to the United States. If an adopted child <10 years old is not vaccinated as part of their pretravel overseas medical examination, the adoptive parents must sign an affidavit indicating their intention to comply with the immunization requirements within 30 days of the child's arrival to the United States. The vaccination affidavit can be found at https://eforms.state.gov/Forms/ds1981.pdf.

VACCINATION RECORDS

Vaccination record reliability differs by, and even within, country of origin. Some children might have full documentation of vaccines received and dates given, while others have incomplete or no records. MMR is not given in most countries of origin because measles vaccine often is administered as a single antigen. In addition, some children might be immune to hepatitis A, measles, mumps, rubella, or varicella because of natural infection. A clinical diagnosis of any of these diseases, however, should not be accepted as evidence of immunity.

CATCH-UP VACCINATIONS

Most international adoptees arrive to the United States already having been vaccinated against diphtheria, hepatitis B, measles, pertussis, polio, tetanus, and tuberculosis (with BCG) in their country of birth. Because *Haemophilus influenzae* type b (Hib), hepatitis A, human papillomavirus, meningococcal, mumps, pneumococcal conjugate, rotavirus, rubella, and varicella vaccines are not given routinely in low- and middle-income countries, however, >90% of newly arrived internationally adopted children need catch-up vaccines to meet ACIP guidelines.

VACCINATION PLAN

Providers can choose 1 of 2 approaches for developing a vaccination plan for internationally adopted children. The first approach is to revaccinate regardless of the child's vaccination record from their birth country. The second approach, applicable to children ≥6 months of age, is to perform antibody testing and to revaccinate accordingly. One exception to this second approach is pertussis; *Bordetella pertussis* antibody titers do not correlate with immune status, although higher protective antibody levels for diphtheria and tetanus could be extrapolated to mean that a child has protection against pertussis, as well.

Hepatitis B is another exception. Anti-HBs as a correlate of vaccine-induced protection has only been determined for people who have completed an approved vaccination series. To be considered immune, ACIP recommends that children with positive hepatitis B surface antibody have documentation of 3 appropriately spaced doses of hepatitis B vaccine. For children with positive hepatitis B surface antibody and positive hepatitis B core antibody, vaccination is not required, as they are considered immune after natural infection.

For children ≥6 months of age, perform testing for diphtheria (IgG), hepatitis B (as outlined above), Hib, and tetanus (IgG). For children ≥12 months of age, also perform testing for hepatitis A, measles, mumps, rubella, and varicella. Since April 2016, many resource-poor countries have used bivalent oral polio vaccine; for children born on or after this date who do not have documentation of receiving IPV according to an approved (US or World Health Organization) schedule, administer the age-appropriate vaccine series. Revaccination with pneumococcal vaccine is recommended because the vaccine has 13 serotypes, and antibody testing would not be cost-effective.

Once the vaccination record has been assessed and antibody level results are available, give any indicated vaccines according to the current ACIP catch-up schedule. If an adopted child is <6 months old and uncertainty remains regarding their vaccination status or the validity of the vaccination record, administer vaccines according to the ACIP schedule.

Noninfectious Disease Screening

Several screening tests for noninfectious diseases should be performed in all or in select internationally adopted children. All children should have a complete blood count with a differential (as previously noted), hemoglobin electrophoresis, and glucose-6-phosphate-dehydrogenase

(G6PD) deficiency screening. Measure serum levels of thyroid-stimulating hormone, and obtain a blood lead level in all internationally adopted children. Consider testing for serum levels of iron, iron-binding capacity, transferrin, ferritin, and total vitamin D 25-hydroxy. Perform vision and hearing screening and a dental evaluation on all children. Consider neurologic and psychological testing if the child's clinical presentation raises concern.

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TRAVELING WITH PETS & SERVICE ANIMALS

Emily Pieracci, Kendra Stauffer

International air and cruise travel with pets require advance planning. Travelers taking a companion or service animal to a foreign country must meet the entry requirements of that country and follow transportation guidelines of the airline or cruise company. Additionally, upon reentering the United States, pets that traveled abroad are subject to the same import requirements as animals that never lived in the United States (see Sec. 4, Ch. 9, Bringing Animals & Animal Products into the United States).

General information about traveling with a pet is available at www.cdc.gov/importation/traveling-with-pets.html. For destination country requirements, travelers should contact the country's embassy in Washington, DC, or the nearest consulate. The International Air Transportation Association also lists the requirements for pets to enter countries at www.iata.org/en/programs/cargo/live-animals/pets. Airline and cruise companies are another

resource for travelers; most have webpages dedicated to traveling with pets.

TRAVELING WITH PETS OUTSIDE THE UNITED STATES

People planning to travel outside the United States with a pet should contact their local veterinarian well in advance of departure for assistance with completing all necessary paperwork and ensuring animal health and medical requirements are met. Depending on the destination country, pets might be required to have updated vaccinations and parasite treatments, International Standards Organization–compatible microchips implanted, and serologic tests prior to travel. Some countries require a coronavirus disease 2019 (COVID-19) test for pets prior to importation.

Completing the stringent testing and permit requirements for some countries (e.g., Australia) can take up to 6 months. People who plan to transport animals should consider the animals' species (e.g., cat, dog); mode of travel (e.g., airplane, cruise ship); season of travel (some carriers will not transport animals during the hottest or coldest parts of the year); and vaccination and testing requirements of the destination country and of transiting countries, if applicable. Transportation carriers might have additional requirements (e.g., breed restrictions for pets traveling in cargo, health certificates), so travelers intending to take pets outside the United States should contact air and cruise lines for information as soon as they are aware of their travel plans.

The US Department of Agriculture (USDA), Animal Plant and Health Inspection Service (APHIS) lists international export regulations for pets at www.aphis.usda.gov/aphis/pet-travel. Pet owners are responsible for making sure requirements of the destination country are met. USDA APHIS often is required to endorse a health certificate prior to an animal leaving the United States; certificates must be accurate, complete, and legible. Failure to meet destination country requirements can cause problems gaining certificate endorsement or difficulties upon arrival in the destination country (e.g., animal quarantine or retesting).

Travelers should be aware that long flights can be hard on pets, particularly older animals, animals with chronic health conditions, very young animals, and short-nosed breeds (e.g., Persian cats, English bulldogs) that can be predisposed to respiratory stress. The US Department of Transportation offers tips for traveling with animals by plane at www.transportation.gov/airconsumer/plane-talk-traveling-animals.

TRAVELING WITH SERVICE ANIMALS OUTSIDE THE UNITED STATES

The Department of Justice (DOJ) Americans with Disabilities Act (ADA) defines a service animal as any dog that is individually trained to do work or perform tasks for the benefit of a person with a disability, including an intellectual, mental, physical, psychiatric, or sensory disability. DOJ does not recognize emotional support animals as service animals, and airline carriers are not required to recognize emotional support animals as service animals.

Air Travel with Service Animals

The cabins of most commercial airplanes are highly confined spaces; passengers are seated in close quarters with limited opportunities to separate passengers from nearby disturbances. Animals on airplanes can pose a risk to the health, safety, and well-being of passengers and crew, and could disturb the safe and efficient operation of the aircraft. Accommodation of passengers traveling with service animals onboard a commercial airplane must be balanced against these concerns.

The Federal Aviation Administration (FAA) Reauthorization Act of 2018 developed minimum standards for service animals. Airline carriers can require passengers traveling with a service animal to document whether that animal has been individually trained to do work or perform tasks to assist the function of the passenger with a physical or mental disability; has been trained to behave in public; is in good health; and has the ability either not to relieve itself on a long (>8 hours) flight or to do so in a sanitary manner.

The US Department of Transportation (DOT) provides 2 forms to document a service animal's behavior, training, and health: Service Animal Air Transportation Form, available from www.transportation.gov/sites/dot.gov/files/2020-12/

Service%20Animal%20Health%20Behavior%20Training%20Form.pdf; and Service Animal Relief Attestation Form for Flight Segments Eight Hours or Longer, available from www.transportation.gov/sites/dot.gov/files/2020-12/Service%20Animal%20Relief%20Form.pdf.

In addition to the requirements already mentioned, airlines might require health certificates and vaccination records. Although airline carriers cannot restrict service dogs based solely on the breed or generalized type of dog, they might limit the number of service animals traveling with a single passenger with a disability, or require service animals be harnessed, leashed, or tethered unless the device interferes with the service animal's work or the passenger's disability prevents use of these devices; in which case, the carrier must permit the passenger to use signal, voice, or other effective means to maintain control of the service animal.

Cruise Ship Travel with Service Animals

Travelers should contact the cruise company they will be traveling with to learn more about each company's service animal policy. Some cruise lines are unable to accommodate animals onboard. Pets, service dogs in training, and emotional support dogs might not be allowed. People traveling aboard a ship with a service dog should consider rules or requirements at ports of call. For instance, many ports of call have strict entry requirements for animals. Travelers with service animals should visit the USDA's pet travel website (www.aphis.usda.gov/aphis/pet-travel) or their service animal's veterinarian to determine each destination country's policy regarding admission of service animals. Some locations do not recognize 3-year rabies vaccines, and annual vaccination might be required; consult with the service animal's veterinarian for more information.

Some locations require that service animals receive parasite treatment prior to arrival, and this information should be included in the service animal's health records. Some locations require that service animals travel with documentation (e.g., an import license), regardless of whether the service animal will disembark the ship. Check with the cruise company or country of destination for details.

Some locations have breed restrictions per the country's dog ordinances. Restricted-breed service animals might not be allowed to board the ship due to the destination country's laws. Travelers should check with the cruise line and country of destination for more information.

Travelers should hand-carry (i.e., not pack in baggage) all of their animals' required documents, including vaccination records. Service animals traveling without proper documentation might not be permitted to board the ship at embarkation.

REENTERING THE UNITED STATES WITH A PET OR SERVICE ANIMAL

Once a pet or service animal leaves the United States, it must meet all entry requirements to reenter, even if the animal has lived in the United States previously (see Sec. 4, Ch. 9, Bringing Animals & Animal Products into the United States).

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8 Travel by Air, Land & Sea

AIR TRAVEL

Tai-Ho Chen, Araceli Rey, Clive Brown

In 2019, 4.5 billion passengers took nearly 47 million international flights. The following year, annual global passenger air travel volume decreased by nearly two-thirds (1.8 billion passengers took 22 million flights), a consequence of the coronavirus disease 2019 (COVID-19) pandemic. The pandemic reversed a trend of annually increasing air travel volume, attributable at least in part to the implementation of travel restrictions by many countries.

To promote safe travel during the pandemic, in July 2020 the US Department of Transportation and other government agencies, including the Centers for Disease Control and Prevention (CDC), collaborated to publish Runway to Recovery: The United States Framework for Airlines and Airports to Mitigate the Public Health Risks of Coronavirus. Runway to Recovery was based in part on the International Civil Aviation Organization (ICAO) report and guidance document, Take Off: Guidance for Air Travel through the COVID-19 Public Health Crisis, which includes a section on public health risk mitigation measures countries can use in the travel sector. These measures, among others, helped bolster passenger and aviation worker confidence that air travel could be conducted safely during the pandemic.

Travelers often have concerns about the health risks of flying on airplanes. Although illness might occur as a direct result of air travel, it is not commonly reported. Some main concerns include exacerbations of chronic medical conditions due to changes in air pressure and humidity; relative immobility during flights leading to thromboembolic disease; and risk for infection due to

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proximity to others on board who could have communicable diseases.

PREFLIGHT MEDICAL CONSIDERATIONS

The Aerospace Medical Association (www.asma.org) recommends evaluating chronic medical conditions and addressing instabilities prior to travel, particularly in people with underlying cardiovascular disease, diabetes, chronic lung disease, mental illness, seizures, stroke, recent surgery, or a history of deep vein thrombosis or pulmonary embolism. Travelers should be current on routine vaccinations and receive destination-specific vaccinations before travel.

Pregnant Travelers

For information on contraindications and precautions related to flying during pregnancy, see Sec. 7, Ch. 1, Pregnant Travelers.

Travelers with Disabilities

The US Transportation Security Administration (TSA) has information for travelers with disabilities and medical conditions that might affect their security screening (see www.tsa.gov/travel/special-procedures). Travelers with Disabilities (Sec. 3, Ch. 2) includes a table of useful online resources (see Table 3-05, Online resources for travelers with disabilities or chronic illnesses). For information on traveling with a service animal, see Sec. 7, Ch. 6, Traveling with Pets & Service Animals.

Travelers Who Require Supplemental Oxygen

Travelers who require supplemental in-flight oxygen should be aware that they must arrange for their own oxygen supplies while on the ground, at departure, during layovers, and upon arrival. Federal regulations prohibit passengers from bringing their own oxygen onboard flights; passengers should notify the airline ≥72 hours before departure if they require in-flight supplemental oxygen. In addition, airlines might not offer in-flight supplemental oxygen on all aircraft or flights, and some airlines permit only Federal Aviation Administration (FAA)–approved portable oxygen concentrators (for details, see www.faa.gov/about/initiatives/cabin_safety/portable_oxygen). Information about screening portable oxygen concentrators at US airports is available at www.tsa.gov/travel/security-screening/whatcanibring/items/portable-oxygen-concentrators.

CABIN AIR PRESSURE & CHRONIC DISEASE

During normal flight conditions, FAA requires that commercial aircraft maintain a cabin pressure equivalent to a maximum altitude of 8,000 ft (≈2,440 m) above sea level. Cabin pressures are typically maintained at an equivalent of 6,000–8,000 ft (≈1,830–2,440 m) above sea level, but newer aircraft can maintain cabin air pressures equivalent to lower altitudes. Most travelers without preexisting health conditions will not notice any effects from the decreased partial pressure of oxygen at these cabin pressures. By contrast, a traveler with anemia (including sickle cell disease), cardiopulmonary disease (especially people who normally require supplemental oxygen), or cerebrovascular disease can experience an exacerbation of their underlying medical condition. In addition, aircraft cabin air is typically dry, usually 10%–20% humidity, which can cause dryness of the mucous membranes of the upper airway and eyes.

Barotrauma

Barotrauma can occur when the pressure inside an air-filled, enclosed body space (e.g., abdomen, middle ear, sinuses) is not the same as the air pressure inside the aircraft cabin. Barotrauma most commonly occurs because of rapid changes in environmental pressure: during ascent, for example, when cabin pressure falls rapidly, and during descent, when cabin pressure quickly rises. Barotrauma most commonly affects the middle ear, and happens when the eustachian tube is blocked and a traveler is unable to equalize the air pressure in the middle ear with the outside cabin pressure.

Middle ear barotrauma is usually not severe or dangerous; rarely, though, it can cause complications (e.g., dizziness, hearing loss, a perforated tympanic membrane, permanent tinnitus). To help reduce the risks of barotrauma associated with cabin air pressure changes, travelers with ear, nose, and sinus infections or severe congestion might choose to postpone flying to prevent pain

or injury, or use oral or nasal decongestants to help alleviate symptoms. Travelers with allergies should continue their regular allergy medications.

Travelers who have had recent surgery, particularly intra-abdominal, cardiothoracic, or intraocular procedures, should consult with their physician before flying. Travelers who participate in scuba diving should observe minimum recommended time intervals between diving and air travel to reduce the risk for altitude-induced decompression sickness (see Sec. 4, Ch. 4, Scuba Diving: Decompression Illness & Other Dive-Related Injuries, for details).

THROMBOEMBOLIC DISEASE

Decreased mobility during travel is associated with a small but measurable increased risk for venous thrombosis and pulmonary embolism, even in otherwise healthy travelers. The overall incidence of symptomatic venous thromboembolism in the month after travel is 1 in 4,600 flights of >4 hours in duration. Risk is increased by longer flight duration and is greater in people with known risk factors (e.g., clotting disorders, estrogen use, severe obesity, pregnancy, recent surgery or trauma, previous thrombosis). The American College of Chest Physicians recommends travelers on longer flights select aisle seats, walk frequently, and perform calf muscle exercises to reduce the risk for thrombosis. People with risk factors might benefit from wearing properly fitted graduated compression stockings (15–30 mmHg at the ankle) during flight. Aspirin has not been shown to decrease risk. See Sec. 8, Ch. 3, Deep Vein Thrombosis & Pulmonary Embolism, for more details).

IN-FLIGHT TRANSMISSION OF COMMUNICABLE DISEASES

Communicable diseases can be transmitted during air travel. People who are acutely ill or still within the infectious period for a specific disease should delay their travel until they are no longer contagious. For example, otherwise healthy adults can transmit influenza to others for 5–7 days, and transmission of respiratory viruses (e.g., measles) has been documented on commercial aircraft.

Travelers should wash their hands frequently and thoroughly or use an alcohol-based hand sanitizer containing ≥60% alcohol, especially after using the airplane lavatory and before eating meals. Some diseases spread by contact with infectious droplets (e.g., when an ill person sneezes or coughs and the secretions or droplets land on another person's face, mouth, nose, or eyes), or when an ill person touches communal surfaces (e.g., door handles, rest room faucets) with contaminated hands. Other people handling the contaminated surfaces can then be inoculated with the contaminant. Practicing good handwashing and respiratory hygiene (covering mouth with a tissue when coughing or sneezing) can help decrease the risk for infection by direct or indirect contact.

Cabin Ventilation & Air Filtration

Large commercial jet aircraft recirculate 35%–55% of the air in the cabin, mixed with outside air. The recirculated air passes through high-efficiency particulate air (HEPA) filters that capture 99.97% of particles (bacteria, larger viruses or virus clumps, fungi) ≥0.3 μm in diameter. Furthermore, laminar airflow generally circulates in defined areas within the aircraft, thus limiting the radius of distribution of pathogens spread by small-particle aerosols. As a result, the cabin air environment is less conducive to the spread of most infectious diseases than typical environmental systems in buildings.

Coronavirus Disease 2019 & Air Travel

COVID-19 transmission during air travel has been documented. In general, COVID-19 transmission risk on aircraft remains difficult to quantify and is likely to be affected by evolving administrative, engineering, and other controls being widely implemented in the commercial air travel sector. In 2020, as described in the introduction to this chapter, US government agencies and the ICAO each developed guidance for the airline industry to use in response to the pandemic. Recommendations included maximizing total cabin airflow on commercial aircraft during both ground and flight operations; implementing surface decontamination measures aimed at reducing risk for contact with infectious droplets; and modifying passenger movement patterns before, during, and after travel.

Travelers should familiarize themselves with the latest COVID-19–related requirements when planning air travel and, as their departure date approaches, follow the guidance of corresponding health authorities. People with confirmed or suspected COVID-19 should not travel until they are no longer thought to be contagious; similarly, those exposed might need to delay travel based on their history of infection or vaccination, according to current guidance.

IN-FLIGHT MEDICAL EMERGENCIES

Increasing numbers of travelers combined with an ever larger percentage of older passengers make the incidence of onboard medical emergencies likely to increase. Medical emergencies occur in ≈1 in 600 flights, or about 16 medical emergencies per 1 million passengers. The most common in-flight medical events are syncope or presyncope (37%); respiratory symptoms (12%); nausea or vomiting (10%); cardiac symptoms (8%); and seizures (6%).

Although in-flight medical emergencies occur, serious illness or death onboard a commercial aircraft is rare. Death was reported in ≈0.3% of medical emergencies, ≈2/3 were due to cardiac conditions. Most commercial airplanes that fly within the United States are required to carry ≥1 approved automated external defibrillator (AED) and an emergency medical kit.

Flight attendants are trained in basic first aid procedures (e.g., cardiopulmonary resuscitation [CPR], use of AEDs) but generally are not certified in emergency medical response. Many airlines use ground-based medical consultants to assist aircrew and volunteer passenger responders in managing medical cases. In nearly 50% of in-flight emergencies, physician volunteers have assisted (see the following chapter in this section, . . .*perspectives*: Responding to Medical Emergencies when Flying). The Aviation Medical Assistance Act, passed in 1998, provides some protection from liability to health care providers who respond to in-flight medical emergencies.

The goal of managing in-flight medical emergencies is to stabilize the passenger until the flight can safely reach ground-based medical care. When considering diversion to a closer airport, the captain must consider the needs of the ill passenger as well as other safety concerns (e.g., landing conditions, terrain, weather). Certain routes (e.g., transoceanic flights) and availability of definitive medical care might limit diversion options.

PREPARING AIRCREW

To better prepare aircrew for international travel, refer to Sec. 9, Ch. 2, Advice for Aircrew. The CDC Travelers' Health website (https://wwwnc.cdc.gov/travel) provides current information and travel health notices. Sec. 8, Ch. 8, Airplanes & Cruise Ships: Illness & Death Reporting & Public Health Interventions, provides advice for aircrew who might encounter passengers with potentially infectious diseases. The CDC Quarantine and Isolation webpage, Airline Guidance (www.cdc.gov/quarantine/air) provides requirements and tools for aircrew dealing with in-flight illness or death among passengers.

8

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RESPONDING TO MEDICAL EMERGENCIES WHEN FLYING

Kristina Angelo, Christopher Dalinkus

You find your seat, buckle up, and the plane takes off. An hour or so into the flight, you hear the flight attendant's request over the public address system, "If there are any medical personnel on the flight, please press your flight attendant call button." As a health care provider on the flight, you ask yourself, "Can I respond? Should I respond?"

Prior to the coronavirus disease 2019 (COVID-19) pandemic, the Federal Aviation Administration (FAA) reported that 2.7 million airline passengers traveled on >44,000 flights daily in the United States. In addition, >4 billion passengers traveled on commercial airlines globally each year, ≈10 million passengers per day. Medical emergencies occur on ≈1 of every 604 flights. The most common emergencies include syncope or presyncope, respiratory symptoms, or nausea and vomiting. For 90% of these emergencies, aircraft continue to their destination. For the remaining 10%, however, aircraft divert to an alternative landing site, most frequently for cardiac arrest, cardiac symptoms (e.g., chest pain), obstetric or gynecologic issues, or possible stroke. Despite the frequency of medical emergencies, the death rate is only ≈0.3%.

MEDICAL SUPPLIES ON AIRCRAFT

US Carriers

The FAA mandates which medical supplies US carrier aircraft flying domestically or internationally must have available onboard. Required medical supplies are listed in the Code of Federal Regulations (14 CFR, Part 121; subpart X, 121.803 and Appendix A). US carrier aircraft with ≥1 flight attendant are required to have a US Food and Drug Administration (FDA)–approved automated external defibrillator (AED), ≥1 first aid kit, and an emergency medical kit (EMK) in the passenger cabin. The number of first aid kits available on an aircraft corresponds to the number of seats: 1 kit for 0–50 seats; 2 for 51–150 seats; 3 for 151–250 seats; 4 for >250 seats.

A list of medications required in the EMK and equipment for administration (e.g., gloves, needles, syringes, adhesive tape, tourniquet) can be found in Box 8-01. A blood pressure cuff, stethoscope, cardiopulmonary resuscitation mask, oropharyngeal airways, and a manual resuscitation device are included for use in the event of a cardiac or pulmonary event.

BOX 8-01 Emergency medical kit (EMK) medication list

Antihistamine (25 mg tablets and 50 mg injectable)
Aspirin (325 mg)
Atropine
Bronchodilator, for inhalation
Dextrose (50%) and saline, for infusion
Epinephrine (1:1,000 and 1:10,000)
Lidocaine
Nitroglycerin tablets (0.4 mg)
Non-narcotic analgesic (325 mg)

International Carriers

EMK contents vary among international carriers, despite guidance from the International Civil Aviation Organization (ICAO). In a 2010 study of 12 European-based airlines, none complied with ICAO standards for EMKs.

LEGAL CONSIDERATIONS

US Domestic Flights

The 1998 Aviation Medical Assistance Act (AMAA) of the United States protects medical personnel from damages in federal or state court for providing good-faith medical care in the event of a medical emergency. The AMAA does not cover gross negligence or willful misconduct.

International Flights

Air carriers flagged in some countries (e.g., Canada, the United Kingdom, the United States) do not require clinicians to respond to in-flight medical emergencies. Other countries state that clinicians have an obligation to respond.

When responding to a medical emergency on an international flight, the AMAA might not apply. Furthermore, it is unclear what entity has jurisdiction over liability for care rendered; the country where the aircraft is registered might have jurisdiction, or jurisdiction could be based on the aircraft's geographic location at the time an incident occurs. In other cases, the medical responder's licensure country is the jurisdiction for liability. Jurisdiction might depend on whether the flight was in the air or on the ground when the incident occurred. Although most airlines and countries offer protection for Good Samaritans, a clinician responding to an emergency, even if an act of good will, might be at risk of litigation.

THINGS TO CONSIDER BEFORE RESPONDING

Have I consumed alcohol on the flight or before boarding? If you have, reconsider responding—you might be at risk for misconduct.

Am I familiar with how to work an AED?

What is my personal level of comfort and clinical competence to evaluate a person with a medical issue?

Am I flying on an international carrier whose flag is not the United States? The legal ramifications of delivering care to a fellow passenger are not always clear.

Box 8-02 provides a checklist for health care providers responding to in-flight medical emergencies.

BOX 8-02 Responding to in-flight medical emergencies: a checklist for health care providers

- ☐ Be calm and confident.
- ☐ Ask alert and oriented passengers for verbal consent to treat.
- ☐ Use flight attendants as assistants, as appropriate. Flight attendants are certified in cardiopulmonary resuscitation (CPR) and in the use of an automated external defibrillator (AED). Ask them for needed items from the first aid kit, EMK, and the AED.
- ☐ Obtain a medical history, check vital signs, and perform a physical examination appropriate to the problem.
- ☐ As necessary, ask for ground-based medical consultation for severely ill passengers; ask flight crew or other passengers to assist with translation; ask for medical equipment from other passengers (e.g., glucometer); and ask for other onboard clinician support (e.g., obstetrician if a pregnancy-related issue).
- ☐ Move patients to an area with more room (and privacy) if it can be done safely.
- ☐ Notify the crew immediately if the passenger is suspected to have a communicable disease or is severely ill.
- ☐ Document your clinical encounter on airline-specific forms.
- ☐ Communicate with the pilot via the cabin crew about the passenger's condition. The pilot has the responsibility to make the decision about diverting the flight.

(continued)

RESPONDING TO MEDICAL EMERGENCIES WHEN FLYING (CONTINUED)

ADDITIONAL CONSIDERATIONS

Deciding to Respond

For US-licensed health care providers, the decision to respond is a personal one, grounded in ethical obligation. Although the United States offers protections for medical personnel who aid ill passengers in good faith, the nature of the medical issue and the possibility that medications or equipment could be missing from the EMK could create a difficult situation. Always be honest with the flight attendants and the pilot regarding your assessment of the patient's condition and your degree of comfort with assisting; if needed supplies are not available aboard the aircraft, communicate this immediately. If traveling on an international carrier's flight, consider both ethics and the flight's legal jurisdiction.

Do Not Resuscitate

If a traveler has a "Do Not Resuscitate" order, you may choose to heed this. Be aware that individual airline policies might require flight attendants to attempt resuscitation despite this documentation.

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. . . *perspectives* chapters supplement the clinical guidance in this book with additional content, context, and expert opinion. The views expressed do not necessarily represent the official position of the Centers for Disease Control and Prevention (CDC).

DEEP VEIN THROMBOSIS & PULMONARY EMBOLISM

Nimia Reyes, Karon Abe

Deep vein thrombosis (DVT) is a condition in which a blood clot develops in the deep veins, usually in the lower extremities. A pulmonary embolism (PE) occurs when a part of the DVT clot breaks off and travels to the lungs, which can be life-threatening. Venous thromboembolism (VTE) refers to DVT, PE, or both. VTE is often recurrent and can lead to long-term complications (e.g., post-thrombotic syndrome after a DVT, chronic thromboembolic pulmonary hypertension after a PE).

Extended periods of limited mobility inherent to long-distance travel could increase a traveler's risk for VTE. An association between VTE and air travel was first reported in the early 1950s; since then, long-distance air travel has become more common, leading to increased concerns about travel-related VTE.

PATHOGENESIS

Virchow's classic triad for thrombus formation is venous stasis, vessel wall damage, and a hypercoagulable state. Prolonged, cramped sitting during long-distance travel interferes with venous flow in the legs, creating venous stasis. Seat-edge pressure to the popliteal area of the legs can aggravate venous stasis and contribute to vessel wall damage. Coagulation activation can result from an interaction between air cabin conditions (e.g., hypobaric hypoxia) and individual risk factors for VTE. Studies of the pathophysiologic mechanisms for the increased risk of VTE after long-distance travel have not produced consistent results, but venous stasis appears to play a major role. Other factors specific to air travel might increase coagulation activation, particularly in travelers with preexisting risk factors for VTE.

INCIDENCE

The annual incidence of VTE in the general population is estimated to be 0.1% but is greater in subpopulations with risk factors for VTE (Box 8-03). The actual incidence of travel-related VTE is difficult to determine because there is no national surveillance for VTE and no consensus on the definition of travel-related VTE, particularly regarding duration of travel and period of observation after travel.

AIR TRAVEL–RELATED VENOUS THROMBOEMBOLISM

Studies estimating the incidence of air travel–related VTE have used various criteria to determine risk factors and end points. For example, investigators have defined long-distance air travel as lasting anywhere from >3 hours to >10 hours. Although no standard definition exists, >4 hours is most often used. Post-flight observation period is similarly inconsistent and ranges from "hours after landing" to ≥8 weeks; 4 weeks, however, is most common. Finally, study outcomes range from asymptomatic DVT to symptomatic DVT/PE to severe or fatal PE. Asymptomatic DVT was estimated to be 5–20 times more common than symptomatic events, but asymptomatic DVT is of uncertain clinical significance and often resolves spontaneously.

In general, the incidence of air travel–related VTE appears to be low. For flights >4 hours, one study reported an absolute risk for VTE of 1 in 4,656 flights; another reported an absolute risk of 1 in 6,000 flights. People who travel on long-distance flights generally are healthier and therefore at a lower risk for VTE than the general population. Five prospective studies conducted to assess the incidence of DVT after travel >8 hours among travelers at low to intermediate risk for VTE yielded an overall VTE incidence of 0.5%; the incidence of symptomatic VTE was 0.3%.

Studies indicate that long-distance air travel might increase a person's overall risk for VTE by 2- to 4-fold. Some studies found that long-distance air travel increased the risk of VTE occurring, while others either found no definitive evidence of increased risk, or found that risk increased only if ≥1 additional VTE risk factors were present. Level of risk correlates with duration of travel and with

BOX 8-03 Venous thromboembolism (VTE) risk factors

- Cancer (active)
- Estrogen use (hormonal contraceptives or hormone replacement therapy)
- Hospitalization, surgery, or trauma (recent)
- Limited mobility (e.g., prolonged bed rest, paralysis, extended period of restricted movement [such as wearing a leg cast])
- Obesity (Body Mass Index [BMI] ≥30 kg/m^2)
- Older age (increasing risk after age 40)
- Pregnancy and the postpartum period
- Previous VTE
- Serious medical illness
- Thrombophilia (inherited or acquired) or a family history of VTE

preexisting risk factors for VTE. Risk decreases with time after air travel and returns to baseline by 8 weeks; most air travel–related VTE occurs within the first 1–2 weeks after the flight.

A similar increase in risk for VTE is noted with other modes of long-distance travel (bus, car, train), which implies that increased risk is due mainly to prolonged limited mobility rather than by the air cabin environment.

RISK FACTORS

Most travel-related VTE occurs in travelers with preexisting risk factors for VTE (Box 8-03). The combination of air travel with preexisting individual risk factors might synergistically increase risk. Some studies have shown that 75%–99.5% of people who developed travel-related VTE had ≥1 preexisting risk factor; one study showed that 20% had ≥5 risk factors. For travelers without preexisting risk factors, the risk of travel-related VTE is low.

For air travelers, height appears to be an additional risk factor; people <1.6 m (5 ft, 3 in) and those >1.9 m (6 ft, 3 in) tall were at increased risk. Because airline seats are higher than car seats and cannot be adjusted to a person's height, air travelers <1.6 m (5 ft, 3 in) tall might be more prone to seat-edge pressure to the popliteal area. Air travelers >1.9 m (6 ft, 3 in) tall are also at increased risk, possibly because taller travelers have less leg room.

CLINICAL PRESENTATION

Signs and symptoms of DVT/PE are nonspecific. Typical signs or symptoms of DVT in the extremities include pain or tenderness, swelling, warmth in the affected area, and redness or discoloration of the overlying skin. The most common signs or symptoms of acute PE include unexplained shortness of breath, pleuritic chest pain, cough or hemoptysis, and syncope.

DIAGNOSIS

Imaging studies are needed for diagnosis. Duplex ultrasonography is the standard imaging procedure for DVT diagnosis. Computed tomographic pulmonary angiography is the standard imaging procedure for diagnosis of PE. Ventilation-perfusion scan is the second-line imaging procedure.

TREATMENT

Anticoagulant medications commonly are used to treat DVT or PE; anticoagulants also are used for VTE prophylaxis. Bleeding can be a complication of anticoagulant therapy. The most frequently used injectable anticoagulants are unfractionated heparin, low molecular weight heparin (LMWH), and fondaparinux. Oral anticoagulants include apixaban, betrixaban, dabigatran, edoxaban, rivaroxaban, and warfarin.

PREVENTIVE MEASURES

The American College of Chest Physicians (ACCP) and the American Society of Hematology (ASH) each provide guidelines on the prevention of VTE in long-distance travelers.

American College of Chest Physicians Guidelines

ACCP 2012 guidelines (Grade 2C: weak recommendations, low- or very low-quality evidence): for long-distance travelers (>6 hours travel) at increased risk of VTE, the ACCP recommends frequent ambulation, calf muscle exercise, sitting in an aisle seat if feasible, and use of properly fitted below-the-knee graduated compression stockings (GCS) providing 15–30 mmHg of pressure at the ankle during travel. For long-distance travelers not at increased risk of VTE, use of GCS is not recommended. ACCP suggests against the use of aspirin or anticoagulants to prevent VTE in long-distance travelers.

American Society of Hematology Guidelines

ASH 2018 guidelines (conditional recommendations, very low certainty in the evidence of effects): for long-distance travelers (>4 hours travel) at substantially increased VTE risk (e.g., recent surgery, prior history of VTE, postpartum, active malignancy, or ≥2 risk factors, including combinations of the above with hormone replacement therapy, obesity, or pregnancy) the ASH guideline panel suggests GCS or prophylactic low molecular weight heparin (LMWH). If GCS or LMWH are not feasible, ASH suggests using aspirin rather than no VTE prophylaxis. For travelers without risk factors, ASH suggests not using GCS, LMWH, or aspirin for VTE prophylaxis.

Graduated Compression Stockings & Pharmacologic Prophylaxis

GCS appear to reduce asymptomatic DVT in travelers and are generally well tolerated. Decisions regarding use of pharmacologic prophylaxis for long-distance travelers at high risk should be made on an individual basis. When the potential benefits of pharmacologic prophylaxis outweigh the possible adverse effects, anticoagulants rather than antiplatelet drugs (e.g., aspirin) are recommended. People at increased risk should be evaluated with enough time before departure so that they understand how to take the medication; evaluate whether the traveler could have potential adverse effects from the combination of pharmacologic prophylaxis with any other medications they are taking.

Hydration

No evidence exists for an association between dehydration and travel-related VTE. Furthermore, no direct evidence exists to support the concept that drinking plenty of nonalcoholic beverages to ensure adequate hydration or avoiding alcoholic beverages has a protective effect. Therefore, maintaining hydration is reasonable and unlikely to cause harm, but it cannot be recommended specifically to prevent travel-related VTE.

In-Flight Mobility & Seat Assignment

Immobility while flying is a risk for VTE. Indirect evidence suggests that maintaining mobility could prevent VTE. In view of the role that venous stasis plays in the pathogenesis of travel-related VTE, recommending frequent ambulation and calf muscle exercises for long-distance travelers is reasonable.

An aisle seat also might be a protective factor to reduce the risk of developing VTE. In one study, travelers seated in window seats experienced a 2-fold increase in general risk for VTE compared with passengers in aisle seats; travelers with a body mass index ≥30 kg/m^2 who sat in window seats had a 6-fold increase in risk. Conversely, aisle seats are reported to have a protective effect compared with window or middle seats, probably because travelers are freer to move around.

RECOMMENDATIONS

General protective measures for long-distance travelers include calf muscle exercises, frequent ambulation, and aisle seating when possible. Additional protective measures for long-distance travelers at increased risk of VTE include properly fitted below-the-knee GCS and anticoagulant prophylaxis, but only in particularly high-risk cases where the potential benefits outweigh the risks.

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JET LAG

Greg Atkinson, Alan Batterham, Andrew Thompson

Jet lag results from a mismatch between a person's circadian (24-hour) rhythms and the time of day in the new time zone. When establishing risk of jet lag, first determine how many time zones a traveler will cross and what the discrepancy will be between time of day at home and at the destination at arrival. During the first few days after a flight to a new time zone, a person's circadian rhythms are still anchored to the time of day at their initial departure location. Rhythms then adjust gradually to the new time zone.

A useful web-based tool for world time zone travel information is available at www.timeandd ate.com/worldclock/converter.html. For travelers crossing ≤3 time zones, especially if they are on a long-haul flight, symptoms (e.g., tiredness) are likely due to fatigue rather than jet lag, and symptoms should abate 1–3 days post-flight.

Many people flying >3 time zones for a vacation accept the risk for jet lag as a transient and mild inconvenience, but people traveling on business or to compete in athletic events might desire advice on prophylactic measures and treatments. If a traveler spends ≤2 days in the new time zone, they might prefer to anchor their sleep–wake schedule to the time of day at home as much as possible. Consider recommending short-acting hypnotics or alertness-enhancing drugs (e.g., caffeine) for such travelers to minimize total burden of jet lag during short round trips.

CLINICAL PRESENTATION

Jet lag symptoms can be difficult to define because of variation among people and because the same person can experience different symptoms after each flight. Jet-lagged travelers typically experience ≥1 of the following symptoms after flying across >3 time zones: gastrointestinal disturbances, decreased interest in food or enjoyment of meals; negative feelings (e.g., anxiety, depression, fatigue, headache, inability to concentrate, irritability); poor performance of physical and mental tasks during the new daytime; and classically, poor sleep, including (but not limited to) difficulty initiating sleep at the usual time of night (after eastward flights), early awakening (after westward flights), and fractionated sleep (after flights in either direction).

Symptoms are difficult to distinguish from the general fatigue resulting from international travel itself, as well as from other travel factors (e.g., hypoxia in the aircraft cabin). Validated multisymptom measurement tools (e.g., Liverpool Jet Lag Index) can help distinguish between jet lag and fatigue. When travelers cross only 1–2 time zones, though, symptoms of and treatment for jet lag are not readily distinguishable from those for general travel fatigue.

In addition to jet lag symptoms, crossing multiple time zones can affect the timing of regular medication used for chronic conditions and illnesses. This can particularly affect patients taking medications with short half-lives that require >1 dose each day. Consider the destination and traveling time when evaluating travelers who take long-term medications, and recommend strategies to keep them on their dosing schedule.

PREVENTION & TREATMENT

Travelers use many approaches—before, during, and after flying—to reduce jet lag symptoms. In one survey, 460 long-haul travelers indicated that seat selection and booking a direct flight were primary strategies to reduce jet lag. Nearly all study participants used ≥1 behavioral strategy during their flight, including consuming or avoiding alcohol and caffeine (81%), altering food intake (68%), using light exposure (53%), periodic walking down the aisle of the plane (35%), and taking medication (15%), including melatonin (8%). Only 1 respondent used a jet lag application on a mobile device. Fewer people used all these strategies before takeoff and after arrival.

After arrival, light and social contacts influence the timing of internal circadian rhythms. A traveler staying in the time zone for >2 days

should quickly try to adjust to the local sleep–wake schedule as much as possible.

Diet & Physical Activity

Most dietary interventions or functional foods have not been proven to reduce jet lag symptoms in randomized controlled trials and real flight conditions (see Sec. 2, Ch. 14, Complementary & Integrative Health Approaches to Travel Wellness). Most trials are in simulated flight conditions and have a high risk of bias, including studies looking at the effectiveness of *Centella asiatica*, elderberry, echinacea, pinokinase, and diets containing various levels of fiber, fluids, or macronutrients. In one study, long-haul flight crew who adopted more regular mealtimes showed a small improvement in their general subjective rating of jet lag, but not the separate symptoms of alertness or jet lag, on their days off work.

Because gastrointestinal disturbance is a common jet lag symptom, travelers might better tolerate smaller meals than larger ones before and during the flight; this strategy has not been investigated in a formal trial, however. Travelers might find caffeine and physical activity can help ameliorate daytime sleepiness at the destination, but little evidence exists to indicate that these interventions reduce overall feelings of jet lag. Any purported treatments based on use of acupressure, aromatherapy, or homeopathy have no scientific basis.

Hypnotic Medications

Prescription medications (e.g., temazepam, zolpidem, zopiclone) can reduce sleep loss during and after travel but do not necessarily help resynchronize circadian rhythms or improve overall jet lag symptoms. If indicated, prescribe the lowest effective dose of a short- to medium-acting compound for the initial few days of travel, bearing in mind these drugs do have adverse effects. In 2019, the US Food and Drug Administration (FDA) issued a warning about rare but serious adverse events (i.e., injuries caused by sleepwalking) occurring after patients took some sleep medications; adverse events were more commonly reported with eszopiclone, zaleplon, and zolpidem (see www.fda.gov/drugs/drug-safety-and-availability/fda-adds-boxed-warning-risk-serious-injuries-caused-sleepwalking-certain-prescription-insomnia).

Caution travelers about taking hypnotics during a flight because the resulting immobility could increase the risk for deep vein thrombosis. Travelers should not use alcohol as a sleep aid, because it disrupts sleep and can provoke obstructive sleep apnea.

Light

Exposure to bright light can advance or delay human circadian rhythms depending on when it is received in relation to a person's body clock time. Consequently, some researchers have proposed schedules for good and bad times for light exposure after arrival in a new time zone (www.caa.co.uk/Passengers/Before-you-fly/Am-I-fit-to-fly/Health-information-for-passengers/Jet-lag).

The best circadian time for light exposure might be at a time that is dark after crossing multiple time zones, raising the question of whether a light box is helpful. One small randomized controlled trial on supplementary bright light for reducing jet lag did not find clinically relevant effects of supplementary light on jet lag symptoms after a flight across 5 time zones going west.

Melatonin & Melatonin-Receptor Analogs

Probably the most well-known treatment for jet lag, melatonin, is secreted at night by the pineal gland. Melatonin delays circadian rhythms when taken during the rising phase of body temperature (usually the morning) and advances rhythms when ingested during the falling phase of body temperature (usually the evening). These effects are opposite to those of bright light.

The instructions on most products advise travelers to take melatonin before nocturnal sleep in the new time zone, irrespective of the number of time zones crossed or direction of travel. Studies published in the mid-1980s indicated a substantial benefit of taking melatonin just before sleep to reduce overall feelings of jet lag after flights. Subsequent larger studies did not replicate these earlier findings, however, and more research on melatonin's use in jet lag is needed.

Melatonin is a very popular sleep aid for jet lag in the United States, and no serious side effects have been linked to its use, although long-term studies have not been conducted. The American Academy of Sleep Medicine and the US National Center for Complementary and Integrative Health suggest that melatonin could be used to reduce symptoms of jet lag, although they caution that melatonin might not be safe when combined with some other medications. In addition, melatonin is considered a dietary supplement in the United States and is not regulated by the FDA. Therefore, the advertised concentration of melatonin has not been confirmed for most products on the market, and the presence of contaminants cannot be ruled out (see Sec. 2, Ch. 14, Complementary & Integrative Health Approaches to Travel Wellness).

A recent UK Drug and Therapeutics Bulletin stated that melatonin might increase the frequency of seizures in people with epilepsy. In addition, because it can potentially induce proinflammatory cytokine production, melatonin should not be taken by those with autoimmune diseases. Due to the potential for these problems, and the limited evidence from randomized controlled trials for any benefits, melatonin is not recommended in the United Kingdom.

Ramelteon, a melatonin-receptor agonist, is an FDA-approved treatment for insomnia. One milligram taken just before bedtime can decrease sleep onset latency after eastward travel across 5 time zones. Higher doses do not seem to lead to further improvements, and the effect of this medication on other symptoms of jet lag and the timing of circadian rhythms is unclear. In a well-designed multicenter trial involving simulated jet lag conditions, tasimelteon (a dual melatonin-receptor agonist) improved jet lag symptoms, including nighttime insomnia and daytime functioning; real-world evidence is needed to support or refute its use in the amelioration of jet lag.

Mobile Applications

Several mobile device applications (apps) can provide tailored advice to manage jet lag symptoms. Depending on how many time zones the traveler has passed through, Timeshifter (www.timeshifter.com) provides advice on when to use caffeine, light, melatonin, and sleep. Another app offering tailored advice was tested for use over several months of frequent flying. Participants reported reduced fatigue compared with the comparator group and improved aspects of health-related behavior (e.g., physical activity, snacking, and sleep quality) but not other measures of sleep (e.g., duration, latency, use of sleep-related medication). Although this and other apps are based on information from published laboratory-based experiments, they lack randomized controlled trials on their effectiveness for reducing jet lag symptoms after actual long-haul flights.

Combination Treatments

Multiple therapies to decrease jet lag symptoms can be combined into treatment packages. Marginal gains from multiple treatments could aggregate. In one small trial, a treatment package involving light exposure and sleep hygiene advice improved sleep quality and physical performance after an eastward flight across 8 time zones. The American Sleep Association offers general sleep hygiene advice at www.sleepassociation.org/about-sleep/sleep-hygiene-tips.

In general, no cure is available for jet lag. Instead, focus counseling on factors known from laboratory simulations to alter circadian timing. Until more randomized controlled trials of treatments prescribed before, during, or after transmeridian flights are published, focus on providing robust, evidence-based advice.

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