CHAPTER 12

Travel Advice for Pediatric Travelers

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Pediatric travelers present unique challenges to the travel medicine provider. Each facet of travel medicine has special caveats relating to the different developmental stages, sizes, and maturity levels of the infant, child, or adolescent traveler. In addition, children traveling to any destination require attention to basic pediatric issues. The pre-travel consultation provides an opportunity to highlight specific travel medicine issues and vulnerabilities in the pediatric population.

DEVELOPMENTAL ASPECTS AND TRAVEL

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

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

Traveling high school and college students are addressed in Chapter 13.

AIRLINE TRAVEL

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

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

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

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

Advice on sedating children with a weight-appropriate dose of over-the-counter antihistamine may be requested by the parent(s) and can be done as close to actual take-off time as possible. Paradoxical reactions to antihistamines occur in a small percentage of children and are best discovered at home, before the plane trip. Prescription sedatives should be avoided. An unanticipated side effect, such as respiratory depression, can be much more serious in-flight, where medical care is unavailable.

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

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

TABLE 12.1 Medications for Motion Sickness

	Dose	Comments
Over-the-counter		
Diphenhydramine	5 mg/kg per day p.o. divided q.i.d.	Strong sedative effect; available in liquid form
Dimenhydrinate	2-5 years: 12.5-25 mg p.o. t.i.d., to maximum 75 mg/day 6-12 years: 25-50 mg p.o. t.i.d., to max. 150 mg/day >12 years: 50 mg p.o. t.i.d. –q.i.d. Adult maximum: 400 mg/day	Available in liquid form
Meclizine	>12 years: 25-50 mg p.o. once daily	Chewable tablet
Prescription		
Scopolamine (Transderm-Scop) 1.5-mg patch	>12 years: 1.5-mg patch behind the ear every 3 days	Apply at least 4 h before expected symptoms; wash hands after applying; do not cut patch
Promethazine	>2 years: 0.5 mg/kg per dose p.o. q12 h p.r.n.; max 25 mg/dose	Good for severe symptoms; may cause profound sedation. Do not use with other respiratory depressants. Contraindicated for those <2 years.

p.o., By mouth; *p.r.n,* as needed; *q.i.d.,* four times per day; *t.i.d.,* three times per day.

MOTION SICKNESS

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

Acceptable and safe medications for motion sickness in children are listed in **Table 12.1**. Over-the-counter preparations will usually suffice for mild to moderate symptoms. The use of promethazine should be reserved for children over 2 years with severe symptoms. Any of these medications are best given 1 hour before the anticipated symptoms occur.

VACCINE SCHEDULES FOR INFANTS AND CHILDREN

Immunization against common vaccine-preventable diseases occurs routinely throughout the first 24 months of life and mirrors routine pediatric health supervision visits. Routine vaccination schedules have changed yearly or more in the past 10 years. In the United States, the varicella vaccine is recommended for all children at 12 months of age and older. The measles, mumps, rubella (MMR) vaccine is recommended at 12 months. It can be administered to infants between 6 and 12 months in outbreak situations and for those whose travel itinerary poses risk. Second doses of both MMR and varicella vaccines are routine at 4-6 years of age. The second dose of MMR vaccine can be given as soon as 1 month after the first dose. The second dose of varicella vaccine can be given 3 months after the first dose if indicated. The injectable inactivated polio vaccination series has been in use in the United States since 2000. The 13-valent pneumococcal conjugate vaccine is recommended for infants and children 2-23 months of age and other defined older at-risk groups. Influenza vaccination is routinely recommended for all children older than 6 months, regardless of

travel plans. Meningococcal meningitis conjugate vaccine is routinely recommended at age 11-12 years, with a booster 5 yrs after the first dose. Licensure of the conjugate vaccine has been extended down to 9 months of age if a travel indication exists. An adolescent booster for both tetanus and pertussis is given at age 10-11 years. The reduced pertussis/tetanus/diphtheria vaccine (Tdap) is given if 5 years have elapsed from the last tetanus shot. Further tetanus boosters should be given as Td (tetanus and diphtheria). Conjugate meningococcal vaccine, if indicated, is best administered at the same time as Tdap. Vaccinations against multiple strains of human papilloma virus (HPV) known to cause cervical cancer are available and recommended routinely in a two- or three-dose series (0, 2, and 6 months) for girls >11 years. Some are also licensed for use in males >11 years to prevent HPV genital infection.

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

International travel increases the risk of exposure to communicable diseases. It is important for a young infant or child going abroad to receive as much protection as possible against preventable diseases. Unique vaccine considerations exist for children, which guide choices before travel. Routine vaccines may have to be given on an accelerated schedule, with recommendations for extra booster doses. An acceptable schedule for accelerating routine vaccines is found in **Table 12.2**. Some travel vaccines, such as yellow fever vaccine, have serious complications in the young infant and are not recommended until a certain age is attained (9 months for yellow fever vaccine). Other vaccines, such as meningococcal polysaccharide vaccine, are not optimally immunogenic in children <2 years old, and more effective options exist in the conjugate vaccines. Still others, such as hepatitis A, are not approved for use in children under certain ages owing to the presence of interfering maternal antibody that limits vaccine response.

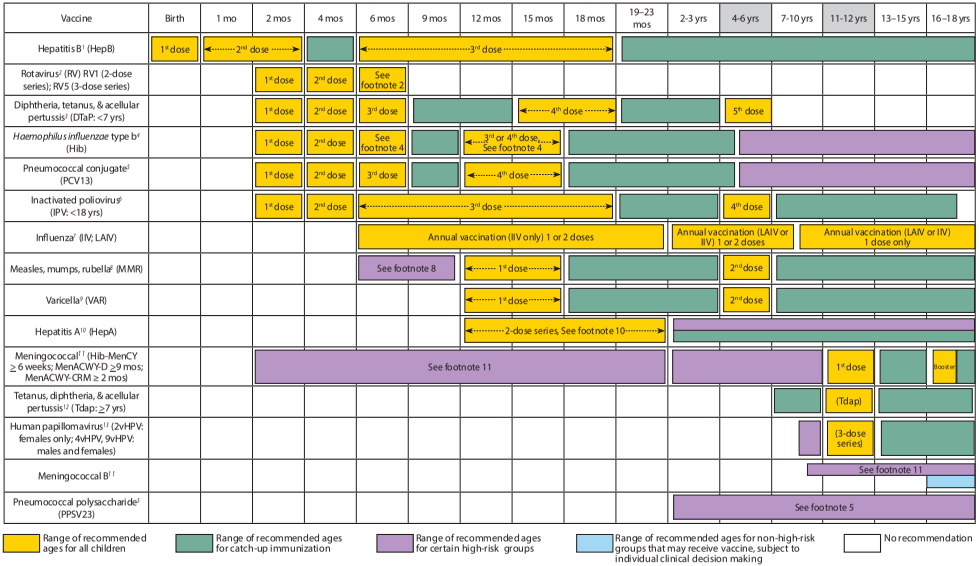
Hepatitis A is usually a mild disease in children <5 years old. Children, however, can serve as reservoirs and can infect adults and caretakers. Continuing to breast-feed traveling infants offers the advantage of added gastrointestinal immunity to enteric diseases. Immunization with the hepatitis A vaccine is recommended for child travelers >1 year without pre-vaccine serology testing. Foreign-born children from developing countries may be considered for serologic testing before vaccination. Recommendations have been made from the Centers for Disease Control and Prevention (CDC) in 2006 for universal childhood

TABLE 12.2 Accelerated Routine Immunization Schedules for Pediatric Travelers[a]

Vaccine	Schedule
DTaP (Diphtheria, tetanus, and acellular pertussis)	6, 10, 14 weeks, and 6 months after dose 3
Measles, mumps, rubella (MMR)	
MMR	6-11 months of age
MMR, two doses	12 months of age, 1 month after first MMR
Inactivated polio vaccine	6, 10, and 14 weeks of age
Haemophilus influenza type B conjugate vaccine	
HbOC, PRP-T	6, 10, 14 weeks, and 12 months
Hepatitis B vaccine	0, 1, 2 months. Give a booster dose at 12 months

[a]Give as many doses as possible of a vaccine series following an accelerated schedule before departure.
HbOC, PRP-T, Haemophilus b conjugate.

These recommendations must be read with the footnotes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars in Figure 1. To determine minimum intervals between doses, see the catch-up schedule (Figure 2). School entry and adolescent vaccine age groups are shaded.



This schedule includes recommendations in effect as of January 1, 2016. Any dose not administered at the recommended age should be administered at a subsequent visit, when indicated and feasible. The use of a combination vaccine generally is preferred over separate injections of its equivalent component vaccines. Vaccination providers should consult the relevant Advisory Committee on Immunization Practices (ACIP) statement for detailed recommendations, available online at http://www.cdc.gov/vaccines/hcp/acip-recs/index.html. Clinically significant adverse events that follow vaccination should be reported to the Vaccine Adverse Event Reporting System (VAERS) online (http://www.vaers.hhs.gov) or by telephone (800-822-7967). Suspected cases of vaccine-preventable diseases should be reported to the state or local health department. Additional information, including precautions and contraindications for vaccination, is available from CDC online (http://www.cdc.gov/vaccines/recs/vac-admin/contraindications.htm) or by telephone (800-CDC-INFO [800-232-4636]).

This schedule is approved by the Advisory Committee on Immunization Practices (http://www.cdc.gov/vaccines/acip), the American Academy of Pediatrics (http://www.aap.org), the American Academy of Family Physicians (http://www.aafp.org), and the American College of Obstetricians and Gynecologists (http://www.acog.org).

NOTE: The above recommendations must be read along with the footnotes of this schedule.

Fig. 12.1 Recommended childhood and adolescent immunization schedules, United States, 2015. The tables in this figure are reproduced from the Centers for Disease Control and Prevention website. Consult the website for access to the complete footnotes. Available at http://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent-compliant.html. *Continued*

Footnotes — Recommended immunization schedule for persons aged 0 through 18 years—United States, 2016

For further guidance on the use of the vaccines mentioned below, see: http://www.cdc.gov/vaccines/hcp/acip-recs/index.html.
For vaccine recommendations for persons 19 years of age and older, see the Adult Immunization Schedule.

Additional information

- For contraindications and precautions to use of a vaccine and for additional information regarding that vaccine, vaccination providers should consult the relevant ACIP statement available online at http://www.cdc.gov/vaccines/hcp/acip-recs/index.html
- For purposes of calculating intervals between doses, 4 weeks = 28 days. Intervals of 4 months or greater are determined by calendar months.
- Vaccine doses administered 4 days or less before the minimum interval are considered valid. Doses of any vaccine administered ≥5 days earlier than the minimum interval or minimum age should not be counted as valid doses and should be repeated as age-appropriate. The repeat dose should be spaced after the invalid dose by the recommended minimum interval. For further details, see *MMWR, General Recommendations on Immunization and Reports* / Vol. 60 / No. 2; Table 1. *Recommended and minimum ages and intervals between vaccine doses* available online at http://www.cdc.gov/mmwr/pdf/rr/rr6002.pdf.
- Information on travel vaccine requirements and recommendations is available at http://wwwnc.cdc.gov/travel/destinations/list.
- For vaccination of persons with primary and secondary immunodeficiencies, see Table 13, "*Vaccination of persons with primary and secondary immunodeficiencies*," in *General Recommendations on Immunization* (ACIP), available at http://www.cdc.gov/mmwr/pdf/rr/rr6002.pdf.; and American Academy of Pediatrics. "Immunization in Special Clinical Circumstances," in Kimberlin DW, Brady MT, Jackson MA, Long SS eds. *Red Book: 2015 report of the Committee on Infectious Diseases. 30th ed.* Elk Grove Village, IL: American Academy of Pediatrics.

1. Hepatitis B (HepB) vaccine. (Minimum age: birth)

Routine vaccination:

At birth:

- Administer monovalent HepB vaccine to all newborns before hospital discharge.
- For infants born to hepatitis B surface antigen (HBsAg)-positive mothers, administer HepB vaccine and 0.5 mL of hepatitis B immune globulin (HBIG) within 12 hours of birth. These infants should be tested for HBsAg and antibody to HBsAg (anti-HBs) at age 9 through 18 months (preferably at the next well-child visit) or 1 to 2 months after completion of the HepB series if the series was delayed; CDC recently recommended testing occur at age 9 through 12 months; see http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6439a6.htm.
- If mother's HBsAg status is unknown, within 12 hours of birth administer HepB vaccine regardless of birth weight. For infants weighing less than 2,000 grams, administer HBIG in addition to HepB vaccine within 12 hours of birth. Determine mother's HBsAg status as soon as possible and, if mother is HBsAg-positive, also administer HBIG for infants weighing 2,000 grams or more as soon as possible, but no later than age 7 days.

Doses following the birth dose:

- The second dose should be administered at age 1 or 2 months. Monovalent HepB vaccine should be used for doses administered before age 6 weeks.
- Infants who did not receive a birth dose should receive 3 doses of a HepB-containing vaccine on a schedule of 0, 1 to 2 months, and 6 months starting as soon as feasible. See Figure 2.
- Administer the second dose 1 to 2 months after the first dose (minimum interval of 4 weeks), administer the third dose at least 8 weeks after the second dose AND at least 16 weeks after the **first** dose. The final (third or fourth) dose in the HepB vaccine series should be administered **no earlier than age 24 weeks**.
- Administration of a total of 4 doses of HepB vaccine is permitted when a combination vaccine containing HepB is administered after the birth dose.

Catch-up vaccination:

- Unvaccinated persons should complete a 3-dose series.
- A 2-dose series (doses separated by at least 4 months) of adult formulation Recombivax HB is licensed for use in children aged 11 through 15 years.
- For other catch-up guidance, see Figure 2.

2. Rotavirus (RV) vaccines. (Minimum age: 6 weeks for both RV1 [Rotarix] and RV5 [RotaTeq])

Routine vaccination:

Administer a series of RV vaccine to all infants as follows:

1. If Rotarix is used, administer a 2-dose series at 2 and 4 months of age.
2. If RotaTeq is used, administer a 3-dose series at ages 2, 4, and 6 months.
3. If any dose in the series was RotaTeq or vaccine product is unknown for any dose in the series, a total of 3 doses of RV vaccine should be administered.

Catch-up vaccination:

- The maximum age for the first dose in the series is 14 weeks, 6 days; vaccination should not be initiated for infants aged 15 weeks, 0 days or older.
- The maximum age for the final dose in the series is 8 months, 0 days.
- For other catch-up guidance, see Figure 2.

3. Diphtheria and tetanus toxoids and acellular pertussis (DTaP) vaccine. (Minimum age: 6 weeks. Exception: DTaP-IPV [Kinrix, Quadracel]: 4 years)

Routine vaccination:

- Administer a 5-dose series of DTaP vaccine at ages 2, 4, 6, 15 through 18 months, and 4 through 6 years. The fourth dose may be administered as early as age 12 months, provided at least 6 months have elapsed since the third dose.
- Inadvertent administration of 4th DTaP dose early: If the fourth dose of DTaP was administered at least 4 months, but less than 6 months, after the third dose of DTaP, it need not be repeated.

3. Diphtheria and tetanus toxoids and acellular pertussis (DTaP) vaccine (cont'd)

Catch-up vaccination:

- The fifth dose of DTaP vaccine is not necessary if the fourth dose was administered at age 4 years or older.
- For other catch-up guidance, see Figure 2.

4. *Haemophilus influenzae* type b (Hib) conjugate vaccine. (Minimum age: 6 weeks for PRP-T [ACTHIB, DTaP-IPV/Hib (Pentacel) and Hib-MenCY (MenHibrix)], PRP-OMP [PedvaxHIB or COMVAX], 12 months for PRP-T [Hiberix])

Routine vaccination:

- Administer a 2- or 3-dose Hib vaccine primary series and a booster dose (dose 3 or 4 depending on vaccine used in primary series) at age 12 through 15 months to complete a full Hib vaccine series.
- The primary series with ActHIB, MenHibrix, or Pentacel consists of 3 doses and should be administered at 2, 4, and 6 months of age. The primary series with PedvaxHIB or COMVAX consists of 2 doses and should be administered at 2 and 4 months of age; a dose at age 6 months is not indicated.
- One booster dose (dose 3 or 4 depending on vaccine used in primary series) of any Hib vaccine should be administered at age 12 through 15 months. An exception is Hiberix vaccine. Hiberix should only be used for the booster (final) dose in children aged 12 months through 4 years who have received at least 1 prior dose of Hib-containing vaccine.
- For recommendations on the use of MenHibrix in patients at increased risk for meningococcal disease, please refer to the meningococcal vaccine footnotes and also to *MMWR* February 28, 2014 / 63(RR01);1-13, available at http://www.cdc.gov/mmwr/PDF/rr/rr6301.pdf.

Catch-up vaccination:

- If dose 1 was administered at ages 12 through 14 months, administer a second (final) dose at least 8 weeks after dose 1, regardless of Hib vaccine used in the primary series.
- If both doses were PRP-OMP (PedvaxHIB or COMVAX), and were administered before the first birthday, the third (and final) dose should be administered at age 12 through 59 months and at least 8 weeks after the second dose.
- If the first dose was administered at age 7 through 11 months, administer the second dose at least 4 weeks later and a third (and final) dose at age 12 through 15 months or 8 weeks after second dose, whichever is later.
- If first dose is administered before the first birthday and second dose administered at younger than 15 months, a third (and final) dose should be administered 8 weeks later.
- For unvaccinated children aged 15 months or older, administer only 1 dose.
- For other catch-up guidance, see Figure 2. For catch-up guidance related to MenHibrix, please see the meningococcal vaccine footnotes and also *MMWR* February 28, 2014 / 63(RR01);1-13, available at http://www.cdc.gov/mmwr/PDF/rr/rr6301.pdf.

Vaccination of persons with high-risk conditions:

- Children aged 12 through 59 months who are at increased risk for Hib disease, including chemotherapy recipients and those with anatomic or functional asplenia (including sickle cell disease), human immunodeficiency virus (HIV) infection, immunoglobulin deficiency, or early component complement deficiency, who have received either no doses or only 1 dose of Hib vaccine before 12 months of age, should receive 2 additional doses of Hib vaccine 8 weeks apart; children who received 2 or more doses of Hib vaccine before 12 months of age should receive 1 additional dose.
- For patients younger than 5 years of age undergoing chemotherapy or radiation treatment who received a Hib vaccine dose(s) within 14 days of starting therapy or during therapy, repeat the dose(s) at least 3 months following therapy completion.
- Recipients of hematopoietic stem cell transplant (HSCT) should be revaccinated with a 3-dose regimen of Hib vaccine starting 6 to 12 months after successful transplant, regardless of vaccination history; doses should be administered at least 4 weeks apart.
- A single dose of any Hib-containing vaccine should be administered to unimmunized* children and adolescents 15 months of age and older undergoing an elective splenectomy; if possible, vaccine should be administered at least 14 days before procedure.

Fig. 12.1, cont'd

For further guidance on the use of the vaccines mentioned below, see: http://www.cdc.gov/vaccines/hcp/acip-recs/index.html.

4. ***Haemophilus influenzae* type b (Hib) conjugate vaccine (cont'd)**
   - Hib vaccine is not routinely recommended for patients 5 years or older. However, 1 dose of Hib vaccine should be administered to unimmunized* persons aged 5 years or older who have anatomic or functional asplenia (including sickle cell disease) and unvaccinated persons 5 through 18 years of age with HIV infection.

   **Patients who have not received a primary series and booster dose or at least 1 dose of Hib vaccine after 14 months of age are considered unimmunized.*

5. **Pneumococcal vaccines. (Minimum age: 6 weeks for PCV13, 2 years for PPSV23)**

   Routine vaccination with PCV13:
   - Administer a 4-dose series of PCV13 vaccine at ages 2, 4, and 6 months and at age 12 through 15 months.
   - For children aged 14 through 59 months who have received an age-appropriate series of 7-valent PCV (PCV7), administer a single supplemental dose of 13-valent PCV (PCV13).

   Catch-up vaccination with PCV13:
   - Administer 1 dose of PCV13 to all healthy children aged 24 through 59 months who are not completely vaccinated for their age.
   - For other catch-up guidance, see Figure 2.

   Vaccination of persons with high-risk conditions with PCV13 and PPSV23:
   - All recommended PCV13 doses should be administered prior to PPSV23 vaccination if possible.
   - For children 2 through 5 years of age with any of the following conditions: chronic heart disease (particularly cyanotic congenital heart disease and cardiac failure); chronic lung disease (including asthma if treated with high-dose oral corticosteroid therapy); diabetes mellitus; cerebrospinal fluid leak; cochlear implant; sickle cell disease and other hemoglobinopathies; anatomic or functional asplenia; HIV infection; chronic renal failure; nephrotic syndrome; diseases associated with treatment with immunosuppressive drugs or radiation therapy, including malignant neoplasms, leukemias, lymphomas, and Hodgkin disease; solid organ transplantation; or congenital immunodeficiency:
     1. Administer 1 dose of PCV13 if any incomplete schedule of 3 doses of PCV (PCV7 and/or PCV13) were received previously.
     2. Administer 2 doses of PCV13 at least 8 weeks apart if unvaccinated or any incomplete schedule of fewer than 3 doses of PCV (PCV7 and/or PCV13) were received previously.
     3. Administer 1 supplemental dose of PCV13 if 4 doses of PCV7 or other age-appropriate complete PCV7 series was received previously.
     4. The minimum interval between doses of PCV (PCV7 or PCV13) is 8 weeks.
     5. For children with no history of PPSV23 vaccination, administer PPSV23 at least 8 weeks after the most recent dose of PCV13.
   - For children aged 6 through 18 years who have cerebrospinal fluid leak; cochlear implant; sickle cell disease and other hemoglobinopathies; anatomic or functional asplenia; congenital or acquired immunodeficiencies; HIV infection; chronic renal failure; nephrotic syndrome; diseases associated with treatment with immunosuppressive drugs or radiation therapy, including malignant neoplasms, leukemias, lymphomas, and Hodgkin disease; generalized malignancy; solid organ transplantation; or multiple myeloma:
     1. If neither PCV13 nor PPSV23 has been received previously, administer 1 dose of PCV13 now and 1 dose of PPSV23 at least 8 weeks later.
     2. If PCV13 has been received previously but PPSV23 has not, administer 1 dose of PPSV23 at least 8 weeks after the most recent dose of PCV13.
     3. If PPSV23 has been received but PCV13 has not, administer 1 dose of PCV13 at least 8 weeks after the most recent dose of PPSV23.
   - For children aged 6 through 18 years with chronic heart disease (particularly cyanotic congenital heart disease and cardiac failure), chronic lung disease (including asthma if treated with high-dose oral corticosteroid therapy), diabetes mellitus, alcoholism, or chronic liver disease, who have not received PPSV23, administer 1 dose of PPSV23. If PCV13 has been received previously, then PPSV23 should be administered at least 8 weeks after any prior PCV13 dose.
   - A single revaccination with PPSV23 should be administered 5 years after the first dose to children with sickle cell disease or other hemoglobinopathies; anatomic or functional asplenia; congenital or acquired immunodeficiencies; HIV infection; chronic renal failure; nephrotic syndrome; diseases associated with treatment with immunosuppressive drugs or radiation therapy, including malignant neoplasms, leukemias, lymphomas, and Hodgkin disease; generalized malignancy; solid organ transplantation; or multiple myeloma.

6. **Inactivated poliovirus vaccine (IPV). (Minimum age: 6 weeks)**

   Routine vaccination:
   - Administer a 4-dose series of IPV at ages 2, 4, 6 through 18 months, and 4 through 6 years. The final dose in the series should be administered on or after the fourth birthday and at least 6 months after the previous dose.

   Catch-up vaccination:
   - In the first 6 months of life, minimum age and minimum intervals are only recommended if the person is at risk of imminent exposure to circulating poliovirus (ie., travel to a polio-endemic region or during an outbreak).
   - If 4 or more doses are administered before age 4 years, an additional dose should be administered at age 4 through 6 years and at least 6 months after the previous dose.
   - A fourth dose is not necessary if the third dose was administered at age 4 years or older and at least 6 months after the previous dose.

6. **Inactivated poliovirus vaccine (IPV). (Minimum age: 6 weeks) (cont'd)**
   - If both OPV and IPV were administered as part of a series, a total of 4 doses should be administered, regardless of the child's current age. If only OPV were administered, and all doses were given prior to 4 years of age, one dose of IPV should be given at 4 years or older, at least 4 weeks after the last OPV dose.
   - IPV is not routinely recommended for U.S. residents aged 18 years or older.
   - For other catch-up guidance, see Figure 2.

7. **Influenza vaccines. (Minimum age: 6 months for inactivated influenza vaccine [IIV], 2 years for live, attenuated influenza vaccine [LAIV])**

   Routine vaccination:
   - Administer influenza vaccine annually to all children beginning at age 6 months. For most healthy, nonpregnant persons aged 2 through 49 years, either LAIV or IIV may be used. However, LAIV should NOT be administered to some persons, including 1) persons who have experienced severe allergic reactions to LAIV, any of its components, or to a previous dose of any other influenza vaccine; 2) children 2 through 17 years receiving aspirin or aspirin-containing products; 3) persons who are allergic to eggs; 4) pregnant women; 5) immunosuppressed persons; 6) children 2 through 4 years of age with asthma or who had wheezing in the past 12 months; or 7) persons who have taken influenza antiviral medications in the previous 48 hours. For all other contraindications and precautions to use of LAIV, see *MMWR* August 7, 2015 / 64(30);818-25 available at http://www.cdc.gov/mmwr/pdf/wk/mm6430.pdf.

   For children aged 6 months through 8 years:
   - For the 2015-16 season, administer 2 doses (separated by at least 4 weeks) to children who are receiving influenza vaccine for the first time. Some children in this age group who have been vaccinated previously will also need 2 doses. For additional guidance, follow dosing guidelines in the 2015-16 ACIP influenza vaccine recommendations, *MMWR* August 7, 2015 / 64(30);818-25, available at http://www.cdc.gov/mmwr/pdf/wk/mm6430.pdf.
   - For the 2016-17 season, follow dosing guidelines in the 2016 ACIP influenza vaccine recommendations.

   For persons aged 9 years and older:
   - Administer 1 dose.

8. **Measles, mumps, and rubella (MMR) vaccine. (Minimum age: 12 months for routine vaccination)**

   Routine vaccination:
   - Administer a 2-dose series of MMR vaccine at ages 12 through 15 months and 4 through 6 years. The second dose may be administered before age 4 years, provided at least 4 weeks have elapsed since the first dose.
   - Administer 1 dose of MMR vaccine to infants aged 6 through 11 months before departure from the United States for international travel. These children should be revaccinated with 2 doses of MMR vaccine, the first at age 12 through 15 months (12 months if the child remains in an area where disease risk is high), and the second dose at least 4 weeks later.
   - Administer 2 doses of MMR vaccine to children aged 12 months and older before departure from the United States for international travel. The first dose should be administered on or after age 12 months and the second dose at least 4 weeks later.

   Catch-up vaccination:
   - Ensure that all school-aged children and adolescents have had 2 doses of MMR vaccine; the minimum interval between the 2 doses is 4 weeks.

9. **Varicella (VAR) vaccine. (Minimum age: 12 months)**

   Routine vaccination:
   - Administer a 2-dose series of VAR vaccine at ages 12 through 15 months and 4 through 6 years. The second dose may be administered before age 4 years, provided at least 3 months have elapsed since the first dose. If the second dose was administered at least 4 weeks after the first dose, it can be accepted as valid.

   Catch-up vaccination:
   - Ensure that all persons aged 7 through 18 years without evidence of immunity (see *MMWR* 2007 / 56 [No. RR-4], available at http://www.cdc.gov/mmwr/pdf/rr/rr5604.pdf) have 2 doses of varicella vaccine. For children aged 7 through 12 years, the recommended minimum interval between doses is 3 months (if the second dose was administered at least 4 weeks after the first dose, it can be accepted as valid); for persons aged 13 years and older, the minimum interval between doses is 4 weeks.

10. **Hepatitis A (HepA) vaccine. (Minimum age: 12 months)**

    Routine vaccination:
    - Initiate the 2-dose HepA vaccine series at 12 through 23 months; separate the 2 doses by 6 to 18 months.
    - Children who have received 1 dose of HepA vaccine before age 24 months should receive a second dose 6 to 18 months after the first dose.
    - For any person aged 2 years and older who has not already received the HepA vaccine series, 2 doses of HepA vaccine separated by 6 to 18 months may be administered if immunity against hepatitis A virus infection is desired.

    Catch-up vaccination:
    - The minimum interval between the 2 doses is 6 months.

Fig. 12.1, cont'd

Continued

For further guidance on the use of the vaccines mentioned below, see: http://www.cdc.gov/vaccines/hcp/acip-recs/index.html.

10. Hepatitis A (HepA) vaccine (cont'd)

Special populations:

- Administer 2 doses of HepA vaccine at least 6 months apart to previously unvaccinated persons who live in areas where vaccination programs target older children, or who are at increased risk for infection. This includes persons traveling to or working in countries that have high or intermediate endemicity of infection; men having sex with men; users of injection and non-injection illicit drugs; persons who work with HAV-infected primates or with HAV in a research laboratory; persons with clotting-factor disorders; persons with chronic liver disease; and persons who anticipate close personal contact (e.g., household or regular babysitting) with an international adoptee during the first 60 days after arrival in the United States from a country with high or intermediate endemicity. The first dose should be administered as soon as the adoption is planned, ideally 2 or more weeks before the arrival of the adoptee.

11. Meningococcal vaccines, (Minimum age: 6 weeks for Hib-MenCY [MenHibrix], 9 months for MenACWY-D [Menactra], 2 months for MenACWY-CRM [Menveo], 10 years for serogroup B meningococcal [MenB] vaccines: MenB-4C [Bexsero] and MenB-FHbp [Trumenba])

Routine vaccination:

- Administer a single dose of Menactra or Menveo vaccine at age 11 through 12 years, with a booster dose at age 16 years.
- Adolescents aged 11 through 18 years with human immunodeficiency virus (HIV) infection should receive a 2-dose primary series of Menactra or Menveo with at least 8 weeks between doses.
- For children aged 2 months through 18 years with high-risk conditions, see below.

Catch-up vaccination:

- Administer Menactra or Menveo vaccine at age 13 through 18 years if not previously vaccinated.
- If the first dose is administered at age 13 through 15 years, a booster dose should be administered at age 16 through 18 years with a minimum interval of at least 8 weeks between doses.
- If the first dose is administered at age 16 years or older, a booster dose is not needed.
- For other catch-up guidance, see Figure 2.

Clinical discretion:

- Young adults aged 16 through 23 years (preferred age range is 16 through 18 years) may be vaccinated with either a 2-dose series of Bexsero or a 3-dose series of Trumenba vaccine to provide short-term protection against most strains of serogroup B meningococcal disease. The two MenB vaccines are not interchangeable; the same vaccine product must be used for all doses.

Vaccination of persons with high-risk conditions and other persons at increased risk of disease:

Children with anatomic or functional asplenia (including sickle cell disease):

Meningococcal conjugate ACWY vaccines:

1. Menveo
   - *Children who initiate vaccination at 8 weeks:* Administer doses at 2, 4, 6, and 12 months of age.
   - *Unvaccinated children who initiate vaccination at 7 through 23 months:* Administer 2 doses, with the second dose at least 12 weeks after the first dose AND after the first birthday.
   - *Children 24 months and older who have not received a complete series:* Administer 2 primary doses at least 8 weeks apart.
2. MenHibrix
   - *Children who initiate vaccination at 6 weeks:* Administer doses at 2, 4, 6, and 12 through 15 months of age.
   - If the first dose of MenHibrix is given at or after 12 months of age, a total of 2 doses should be given at least 8 weeks apart to ensure protection against serogroups C and Y meningococcal disease.
3. Menactra
   - *Children 24 months and older who have not received a complete series:* Administer 2 primary doses at least 8 weeks apart. If Menactra is administered to a child with asplenia (including sickle cell disease), do not administer Menactra until 2 years of age and at least 4 weeks after the completion of all PCV13 doses.

Meningococcal B vaccines:

1. Bexsero or Trumenba
   - *Persons 10 years or older who have not received a complete series.* Administer a 2-dose series of Bexsero, at least 1 month apart. Or a 3-dose series of Trumenba, with the second dose at least 2 months after the first and the third dose at least 6 months after the first. The two MenB vaccines are not interchangeable; the same vaccine product must be used for all doses.

Children with persistent complement component deficiency (includes persons with inherited or chronic deficiencies in C3, C5-9, properidin, factor D, factor H, or taking eculizumab (Soliris®)):

Meningococcal conjugate ACWY vaccines:

1. Menveo
   - *Children who initiate vaccination at 8 weeks:* Administer doses at 2, 4, 6, and 12 months of age.
   - *Unvaccinated children who initiate vaccination at 7 through 23 months:* Administer 2 doses, with the second dose at least 12 weeks after the first dose AND after the first birthday.
   - *Children 24 months and older who have not received a complete series:* Administer 2 primary doses at least 8 weeks apart.
2. MenHibrix
   - *Children who initiate vaccination 6 weeks:* Administer doses at 2, 4, 6, and 12 through 15 months of age.
   - If the first dose of MenHibrix is given at or after 12 months of age, a total of 2 doses should be given at least 8 weeks apart to ensure protection against serogroups C and Y meningococcal disease.

11. Meningococcal vaccines (cont'd)

3. Menactra
   - *Children 9 through 23 months:* Administer 2 primary doses at least 12 weeks apart.
   - *Children 24 months and older who have not received a complete series:* Administer 2 primary doses at least 8 weeks apart.

Meningococcal B vaccines:

1. Bexsero or Trumenba
   - *Persons 10 years or older who have not received a complete series.* Administer a 2-dose series of Bexsero, at least 1 month apart. Or a 3-dose series of Trumenba, with the second dose at least 2 months after the first and the third dose at least 6 months after the first. The two MenB vaccines are not interchangeable; the same vaccine product must be used for all doses.

For children who travel to or reside in countries in which meningococcal disease is hyperendemic or epidemic, including countries in the African meningitis belt or the Hajj

- administer an age-appropriate formulation and series of Menactra or Menveo for protection against serogroups A and W meningococcal disease. Prior receipt of MenHibrix is not sufficient for children traveling to the meningitis belt or the Hajj because it does not contain serogroups A or W.

For children at risk during a community outbreak attributable to a vaccine serogroup

- administer or complete an age- and formulation-appropriate series of MenHibrix, Menactra, or Menveo, Bexsero or Trumenba.

For booster doses among persons with high-risk conditions, refer to *MMWR* 2013 / 62(RR02);1-22, available at http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6202a1.htm.

For other catch-up recommendations for these persons, and complete information on use of meningococcal vaccines, including guidance related to vaccination of persons at increased risk of infection, see *MMWR* March 22, 2013 / 62(RR02);1-22, and *MMWR* October 23, 2015 / 64(41); 1171-1176 available at http://www.cdc.gov/mmwr/pdf/rr/rr6202.pdf, and http://www.cdc.gov/mmwr/pdf/wk/mm6441.pdf.

12. Tetanus and diphtheria toxoids and acellular pertussis (Tdap) vaccine. (Minimum age: 10 years for both Boostrix and Adacel)

Routine vaccination:

- Administer 1 dose of Tdap vaccine to all adolescents aged 11 through 12 years.
- Tdap may be administered regardless of the interval since the last tetanus and diphtheria toxoid-containing vaccine.
- Administer 1 dose of Tdap vaccine to pregnant adolescents during each pregnancy (preferred during 27 through 36 weeks gestation) regardless of time since prior Td or Tdap vaccination.

Catch-up vaccination:

- Persons aged 7 years and older who are not fully immunized with DTaP vaccine should receive Tdap vaccine as 1 (preferably the first) dose in the catch-up series; if additional doses are needed, use Td vaccine. For children 7 through 10 years who receive a dose of Tdap as part of the catch-up series, an adolescent Tdap vaccine dose at age 11 through 12 years should NOT be administered. Td should be administered instead 10 years after the Tdap dose.
- Persons aged 11 through 18 years who have not received Tdap vaccine should receive a dose followed by tetanus and diphtheria toxoids (Td) booster doses every 10 years thereafter.
- Inadvertent doses of DTaP vaccine:
  - If administered inadvertently to a child aged 7 through 10 years may count as part of the catch-up series. This dose may count as the adolescent Tdap dose, or the child can later receive a Tdap booster dose at age 11 through 12 years.
  - If administered inadvertently to an adolescent aged 11 through 18 years, the dose should be counted as the adolescent Tdap booster.
- For other catch-up guidance, see Figure 2.

13. Human papillomavirus (HPV) vaccines. (Minimum age: 9 years for 2vHPV [Cervarix], 4vHPV [Gardasil] and 9vHPV [Gardasil 9])

Routine vaccination:

- Administer a 3-dose series of HPV vaccine on a schedule of 0, 1-2, and 6 months to all adolescents aged 11 through 12 years. 9vHPV, 4vHPV or 2vHPV may be used for females, and only 9vHPV or 4vHPV may be used for males.
- The vaccine series may be started at age 9 years.
- Administer the second dose 1 to 2 months after the first dose (minimum interval of 4 weeks); administer the third dose 16 weeks after the second dose (minimum interval of 12 weeks) and 24 weeks after the first dose.
- Administer HPV vaccine beginning at age 9 years to children and youth with any history of sexual abuse or assault who have not initiated or completed the 3-dose series.

Catch-up vaccination:

- Administer the vaccine series to females (2vHPV or 4vHPV or 9vHPV) and males (4vHPV or 9vHPV) at age 13 through 18 years if not previously vaccinated.
- Use recommended routine dosing intervals (see Routine vaccination above) for vaccine series catch-up.

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Fig. 12.1, cont'd

vaccination against hepatitis A. Parents of children <1 year old can be given the option of immune globulin for the infant, although it is not essential, given the mild nature of the disease in young children.

Typhoid vaccination is similarly complicated by the choices available. The oral typhoid vaccine (Ty21a) in capsule form is approved for use in children >6 years. A lyophilized vaccine preparation that reconstitutes to a liquid oral suspension is available in Canada and Switzerland. This preparation can be used in children >3 years. The injectable typhoid Vi polysaccharide vaccine is an approved alternative in all countries for children >2 years. For younger infants, prudent and cautious food and water advice needs to be emphasized. **Table 12.3** indicates the recommended ages and intervals for travel immunizations. **Table 12.4** lists important vaccine interactions.

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

Rabies vaccination (**Table 12.4** and Chapter 5) is recommended for ambulatory children who will travel extensively (1-3 months) or live in rural villages in countries where rabies is endemic or for anyone who desires maximal protection for the itinerary. Consideration for vaccination should be given to the availability of rabies immune globulin in case post-exposure prophylaxis is needed. The initial treatment of animal bites with soap and water and first-aid measures must be emphasized, along with the importance of obtaining post-exposure rabies prophylaxis within 24 hours.

A tuberculosis (TB) skin test is recommended for children before, if the TB status is unknown, and after extended travel in tropical and developing countries. Bacillus Calmette-Guérin (BCG) vaccine administration in the United States is controversial. Some advocate its use for infants <1 year old if high-risk travel to rural, endemic areas is planned. BCG vaccine decreases the incidence of TB meningitis in this age group. Official US recommendations for BCG vaccine administration are limited to (1) continuous exposure to an untreated or ineffectively treated person with infectious TB or multidrug-resistant (MDR) TB when the child cannot be removed from the environment or (2) healthcare workers in settings with a high percentage of MDR TB and an unsuccessful TB control program. It is contraindicated in immune-deficient persons.

MALARIA PREVENTION

Personal Protective Measures

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

Malaria is transmitted by biting female *Anopheles* mosquitoes, which feed mainly between the hours of dusk and dawn. The risk of exposure to malaria in an infant or child can be greatly reduced by the following precautions: (1) limit outdoor exposure during the hours between dusk and dawn; (2) wear protective clothing that covers most of the body when outdoors (a hooded "bug suit" that covers head, arms, body, and legs can be made out of mosquito netting or is commercially available); (3) use diethyltoluamide (DEET)-containing insect repellent of ≤35%, sparingly, on exposed areas of skin when outdoors (see Chapter 6); (4) spray a permethrin-containing insecticide on external clothing (see Chapter 6); and (5) sleep under a permethrin-impregnated mosquito net at night (see Chapter 6). The use

TABLE 12.3 Travel Vaccinations for Children

Vaccine	Age	Primary Series	Booster Interval; Comments
Cholera, oral (CVD103-HgR)[a,b]	>2 years	1 dose oral, in buffered solution	Optimal interval not established, manufacturer recommends 6 months
Hepatitis A	>1 year	Havrix (GSK): two doses (0.5 mL i.m.) at 0, 6-18 months later VAQTA (Merck): two doses (0.5 mL i.m.) at 0 and 6 months	See text
Immune globulin	Birth	0.02 mL/kg i.m.	Lasts 6 weeks; see text
Japanese B encephalitis (IXIARO®)	2 mos through 2 yrs	2 doses (0.25 mL i.m.) at 0 and 28 days	No data for booster to date
		>3 years: two doses (0.5 mL i.m.) at 0 and 28 days	No data for booster to date
Meningococcal meningitis, conjugate[c]	9 mos	2 doses: (0.5 mL i.m.) – 0 and 3 mos	3 yrs after primary series, then every 5 yrs if exposure risk
Menactra®	11-55 yrs	1 dose	5 yrs after first dose
Menveo®	2 mos	4 doses: 2,4,6 and 12 mos	3 yrs after primary series, then every 5 yrs if exposure risk
	11-55 yrs	1 dose (0.5 mL i.m.)	5 yrs after first dose
Meningococcal meningitis, polysaccharide	>2 years	1 dose (0.5 mL s.c.)	Boost after 2-3 years if first dose was given before 4 years old
Plague vaccine	>18 years	Not for use in children	
Rabies vaccine	Any age	Three doses (1 mL i.m., deltoid [or anterolateral thigh in infants] or 0.1 mL i.d.) at 0, 7, and 21 or 28 days	Only HDCV approved for intradermal (i.d.) use
Typhoid, Ty21a,[b] oral	>3 years[a]	Three doses: 1 sachet p.o. in 100 mL water every other day	Liquid vaccine[a] booster: 7 years
	>6 years	Four doses: 1 capsule p.o. every other day	Capsule vaccine booster: 5 years
Typhoid, Vi polysaccharide, parenteral	>2 years	One dose (0.5 mL i.m.)	Boost after 2 years for continued risk of exposure
Yellow fever[b]	>9 months	1 dose (0.5 mL s.c.)	10 years; see text

[a]Not approved in the United States. Available in Canada and Switzerland.
[b]Caution: may be contraindicated in patients with any of the following conditions: pregnancy, leukemia, lymphoma, generalized malignancy, immunosuppression resulting from HIV infection or treatment with corticosteroids, alkylating drugs, antimetabolites, or radiation therapy.
[c]See reference CDC Health information for international travel 2016. Hib-MenCY-TT(MenHibrix not indicated for traveling infants).
HDCV, Human diploic cell rabies vaccine; *i.d.,* intradermally; *i.m.,* intramuscularly; *p.o.,* by mouth; *s.c.,* subcutaneously.

TABLE 12.4 Vaccine Interactions

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

[a]These recommendations are based on theoretical considerations; efficacy studies are in progress.
OPV, Oral polio vaccine; *PPD,* purified protein derivative.
From: CDC. Health Information for International Travel 2016.

of permethrin-impregnated bed nets has been studied in many rural malarious areas, with a dramatic decrease in the transmission of malaria, even when chemoprophylaxis is not being used.

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

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

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

Chemoprophylaxis

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

chloroquine-sensitive areas as chloroquine. In the United States, hydroxychloroquine is significantly less expensive than chloroquine.

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

Primaquine phosphate is used for eradication of latent incubating *Plasmodium vivax* or *Plasmodium ovale* malaria parasites in the liver after intense exposure in endemic areas (**Table 12.5** and Chapter 6). The glucose 6-phosphate dehydrogenase level must be checked

TABLE 12.5 Drugs Used for Malaria Chemoprophylaxis in Children

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

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

prior to prescribing primaquine, as it is a potent red blood cell oxidizer in those who have inadequate or deficient levels of this enzyme present. No studies have been done on loading doses of antimalarials in children, and such practices are not recommended in pediatric age groups at this time. A summary of antimalarial drugs and pediatric dosing is found in **Table 12.5**.

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

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

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

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

DIARRHEA PREVENTION AND TREATMENT

Prevention of diarrhea in children is especially important during travel in hot, tropical climates, since children rapidly become dehydrated during diarrheal illnesses. Safe food and

TABLE 12.6 Drugs Used for standby therapy of Malaria in Children

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

[a]Once daily dose for 3 consecutive days.
Adapted from CDC 2016.

water selection is the same as for travelers in general and is outlined in Chapter 8 and discussed in detail in Chapter 9. Breast milk is ideal for the traveling infant. Other milk should be boiled, pasteurized, or irradiated. Ultra-high temperature labeled milk, sterilized by flash heating to 137°C for 2-4 s, is an alternative that does not require refrigeration until opening. In addition to preventing diarrheal illness, meticulous attention to safe food and water selection will also decrease exposure to intestinal parasites. The worldwide burden of *Ascaris* and hookworm is carried mainly by children through ingestion of these pathogens. Hand washing, especially before eating; nail trimming; and wearing shoes are simple ways to interrupt transmission of these common parasites. The use of alcohol-based hand sanitizer is encouraged.

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

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

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

Bulking agents, such as kaolin and pectin, have little effect on overall disease and are not recommended. Probiotics including various species of the genus *Lactobacillus* have been studied for their effect in children, with favorable results. Antibiotic-associated diarrhea and viral diarrhea have been shown to be reduced to varying degrees by probiotics. The US Food and Drug Administration (FDA) does not currently regulate these supplements; thus, precise dosing and recommendations have not been published to date. The exact role of these supplements in traveling children has not been delineated, but it points to an interesting direction in diarrhea intervention.

Safety and efficacy influence antibiotic treatment of traveler's diarrhea in infants and young children. Choices for treatment in children differ slightly from those for adults. The antibiotics that are considered safe for pediatric use are not necessarily effective against some of the emergent drug-resistant strains of bacterial pathogens implicated in traveler's diarrhea (Chapter 8). Azithromycin is considered the first choice for pediatric traveler's diarrhea. Quinolones are approved by the FDA for use in children <18 years old for specific infections (resistant urinary tract and bone infections). While experience with quinolones in children has not borne out the potential risk of the joint toxicity seen in experimental animals, widespread recommendations on using this class of drugs in children have not been made. Many advocate that the benefits of a 3-day course off label of quinolones for children with traveler's diarrhea outweigh the risks for this potentially severe disease. Nalidixic acid, a nonfluorinated quinolone, has a long history of use in children for urinary tract infections. It is used in many countries for pediatric traveler's diarrhea and is effective against some strains of *Escherichia coli* and *Shigella* resistant to other drugs. Arthropathy has not been reported in children taking nalidixic acid. However, it has the same theoretical contraindications as fluoroquinolones and is not approved by the FDA for use in children <18 years old unless the potential benefit justifies the risk. Obtaining informed consent is recommended if quinolones are prescribed for pediatric patients.

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

Dietary energy intake improves nutritional outcome in pediatric diarrheal disease. Early enteral feeding stimulates intestinal cell renewal. Parents can continue breast feeding or restart full-strength lactose-free or lactose-reduced formula in bottle-fed infants as soon as rehydration has occurred. Cow's milk products should be reintroduced gradually. The incidence of true post-diarrheal lactose intolerance varies. Severe rotaviral illness is the pediatric enteritis most likely to be associated with lactose intolerance and malabsorption, with rates reported as high as 60-80%. Most infants with mild to moderate rotaviral illness can return directly to cow's milk-based formula. The "BRAT" diet—bananas, rice, applesauce, and toast—has traditionally been advised for diarrheal illness, despite the lack of protein and energy. No evidence exists that this restrictive diet is necessary or advantageous

for diarrhea treatment. Starches, cereals, yogurt, fruits, meats, and low-fiber vegetables are good alternatives. Foods high in simple sugars and fats should be avoided in favor of complex carbohydrates until intestinal recovery has occurred.

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

GENERAL SAFETY FOR TRAVELING CHILDREN AND ADOLESCENTS

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

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

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

ALTITUDE

Children who accompany their parents to high-altitude destinations are at risk of developing altitude-related illnesses. The diagnosis of altitude illness is more difficult to recognize in young children. Nonspecific symptoms that cannot be verbalized, like irritability, anorexia, and headache, mark the onset of potential altitude illness. Rapid descent is critical if any questionable illness or behavioral change occurs. Several studies have shown that infants and young children born at sea level are perhaps more at risk of high-altitude pulmonary edema than adults. Viral respiratory illnesses appear to increase this risk. Children with chronic lung disease, cardiac lesions with increased pulmonary blood flow, or sickle cell disease have been shown to have a predisposition to develop altitude illness. Children with Down syndrome are particularly vulnerable to altitude illness, especially pulmonary edema.

Precautions against altitude illness in children are identical to those for adults: acclimatization by slow ascent and sleeping at altitudes below maximum daily altitudes (see Chapter 10). If air travel to high altitude precludes slow acclimatization, rest and avoidance of dehydration and over-exercise in the early stages of the trip are best advised. Preventive medications, such as acetazolamide, have not been conclusively studied in children. For children who have demonstrated past acute mountain sickness or who are traveling to a high-altitude location without the ability to slowly acclimatize (i.e., flying to La Paz, Bolivia, or Cuzco, Peru), a weight-adjusted dose of acetazolamide (5 mg/kg per day divided b.i.d.)

can be considered. Likewise, there are no data on the use of pharmaceuticals to treat mountain sickness in children.

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

MISCELLANEOUS ISSUES FOR YOUNG TRAVELERS

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

A suggested medical kit for travel with children is found in **Table 12.7**. Any essential medications, especially for asthma, anaphylaxis, or chronic disease, should be labeled and carried on board the airplane. Any child with a chronic disease should have a visit with the regular provider before travel. Children with asthma need to have their asthma management

TABLE 12.7 Recommended Medical Kit for Travel with Children

Medical card with age, weight, any important medical history, allergies, blood type if known, immunization records, and passport copy
Over-the-counter medications:
barrier cream (zinc oxide and petrolatum) for use on raw diaper areas
Acetaminophen
Ibuprofen
Antihistamine (e.g., diphenhydramine)
1% Hydrocortisone cream
Cough suppressant
Antibacterial skin ointment
Bismuth subsalicylate/loperamide, depending on age
Antifungal cream
Prescription medications:
Any regularly taken, with adequate supply
Antibiotic treatment dose for traveler's diarrhea
Antimalarial medication, if indicated
Consider:
Antibiotic if child has recurrent otitis
Injectable epinephrine kit, if there is a history of severe allergic reaction to insect stings or foods
Antibiotic eye drops
Medication for motion sickness, if susceptible

Continued

TABLE 12.7 Recommended Medical Kit for Travel with Children—cont'd

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

For wilderness adventures, add:
- Thermal reflective blanket
- Structural aluminum malleable (SAM) splint
- Fingertip pulse oximeter

plan updated. It is advisable to review the management of asthma exacerbations and carry an adequate supply of inhalers and steroids in case of emergency. Evacuation insurance is a prudent purchase for all travelers, since medical evacuations are not a standard part of US health plans.

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